APPRAISAL REPORT
LOWELL, MASSACHUSETTS
MERRIMACK RIVER

LOCAL FLOOD PROTECTION

MARCH 1985

US ARMY CORPS
OF ENGINEERS
NEW ENGLAND DIVISION

APPRAISAL REPORT
LOCAL PROTECTION PROJECT
LOWELL, MASSACHUSETTS

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I. INTRODUCTION

A. Authority

The city of Lowell is located along both banks of the Merrimack River in Massachusetts' Middlesex County. Primarily a manufacturing community, Lowell had a 1980 population just under 100,000. The mouth of the Merrimack is approximately 40 miles downstream, and its drainage area at Lowell is 4,230 square miles.

The project is a unit in the comprehensive flood protection plan for the Merrimack River Basin authorized by the 1936 Flood Control Act and modified by the 1938 Flood Control Act.

EC 11-2-147 provides direction to review the adequacy of completed local protection projects which were specifically authorized by Congress. Development in watershed areas and new information on basin hydrology since the project's construction may warrant an updated analysis of the degree of protection being realized. The objective is to determine whether it is advisable to modify the structure due to changes either in the area being protected or to make changes to the project to improve it's viability, safety, and reliability.

B. Purpose and Scope.

The purpose of this investigation is to assess the adequacy of the existing local protection project on the Merrimack River through Lowell, Massachusetts, and determine if modifications are advisable and warrant further Federal study.

The scope of this particular report is of a reconnaissance nature. The objectives are:

- Compile existing information
- Initiate public involvement
- Establish the need for modification
- Identify modification opportunities
- Determine preliminary feasibility of modifications
- Recommend future course(s) of action

The study process is divided into two phases - reconnaissance and feasibility. In reconnaissance, modifications to the project are screened from the standpoints of economic, environmental, and engineering integrity and safety considerations. The detail used is strictly at the level of initial appraisal. Items of local cooperation, both past and future, are addressed when an affirmative action is recommended.

If warranted, the feasibility phase would detail the actual modification alternatives and recommend a particular course of action. The recommendation would be based on a comparison of each alternatives expected accomplishments.

C. Public Coordination

The city of Lowell was notified by letter, dated 16 May 84, of the New England Division's (NED) initiation of study efforts to review the existing local protection project (LLP) for the advisability of possible modification.

On 15 May and 31 July 84, personnel from NED visited the project and protected area. Meetings were held with the city's Planning Director and Engineer to discuss the investigation and obtain their views. Both cited local funding as their main restriction toward keeping the project in satisfactory condition.

D. Other Studies

1. The most recent semi-annual inspection was conducted 18 October 84. The project was found in unsatisfactory condition. Deficient items of significance noted include:

- West Street Pumping Station - inoperative due to pump engine failure.

- Vegetation growth along dikes and floodwall - needs to be removed.

2. VTN Consolidated, Inc. studied rehabilitation of West Street Pumping Station in May 1984.

3. Whitman and Howard, Inc. also studied the West Street Pumping Station rehabilitation requirements in May 1984.

4. The Federal Emergency Management Agency's, Flood Insurance Study became effective in February 1984.

5. NED's Water Control Branch completed a report in May 1983 which included a review, update and analysis of interior drainage facilities and needs at the project. The purpose of the study was to provide information and discussion regarding the planning for comprehensive drainage system improvements and replacements in the area.

II. EXISTING CONDITIONS

A. Project History and Description

1. Construction

The existing Local Protection Project (LPP) was constructed in 1943 and 1944. The protection starts at Bridge Street, opposite and upstream from the mouth of the tributary Concord River, and extends upstream along the left (north) bank of the Merrimack River and then along the left bank of the tributary Beaver Brook to near Bachman Street and the Lowell-Dracut town line. The project consists of two sections: Lakeview and Rosemont. Lakeview is located between the Bridge and Aiken Street bridges. Rosemont is near the mouth of Beaver Brook. Plate 1 depicts the project area.

The project's first cost was $580,600 in 1943. This included items of local cooperation (lands, easements, rights-of-way, etc.) amounting to $90,000. By comparison, this same construction cost in today's dollars would be over $8 million.

(a) Lakeview Section

This portion of the LPP has about 2700 linear feet of earth dike and 880 linear feet of concrete floodwall founded on steel sheet piling. The upstream and downstream design elevations are at 73.8 and 72.0 ft. NGVD, about 10 feet above original riverbank. A pumping station, with a total capacity of 340 cubic feet per second (cfs), is located about midway at West Street. This station is presently in a state of complete disrepair. No pumps are presently operable. A large interceptor sewer was constructed along the line of protection during the 1970's. This sewer intercepts the combined sanitary-storm runoff, originally discharging into the river, and conveys it southward to a large centrally located treatment plant. An emergency 7 by 8-foot sluice gate is manually operated to permit diversion of flows from the new interceptor to the station's gravity outlet.

(b) Rosemont Section

Like the Lakeview portion, the measures protecting Rosemont orignially included a pumping station for Beaver Brook together with an earth dike and concrete floodwall along the Merrimack River. However, construction of the large interceptor sewer along the line of protection during the 1970's replaced the need for the pumping station, which was removed in 1982 (with Corps of Engineers approval).

The Rosemont dike starts at the former Beaver Street pumping station site and extends about 800 linear feet downstream along the left bank of Beaver Brook and the Merrimack River. The floodwall also starts at the

former pumping station site and extends 800 linear feet upstream. A 30-foot wide opening in the wall accommodates Beaver Street (elevation 68.0 ft. NGVD); however, during flood periods, stoplogs are used to close off this opening. The top of the protection is at elevation 75.0 ft NGVD for a distance of approximately 500 feet downstream, then it rises to elevation 79.0 feet NGVD for the remaining 300 feet - also about 10 feet above original riverbank. Plate 2 illustrates a general plan and typical sections of the protective measures.

2. Modifications

As mentioned above, during the 1970's the city of Lowell constructed a large comprehensive sewage treatment system. As part of that system, a large interceptor sewer was constructed along the line of protection through both the Rosemont and Lakeview sections. The interceptor sewer is 72 inches in diameter at the former Beaver Street Pumping station site, providing an estimated capacity of about 70 cfs. At the West Street station the interceptor sewer is 96 inches in diameter with an estimated capacity of about 120 cfs. There the sewer passes in front of the facility, intercepting those sewers originally discharging to the station, and continues downstream to the treatment plant. There is a 7 x 8-foot sluice gate at the West Street station that permits emergency diversion of flows from the new interceptor into the station. A general plan of the West Street pumping station, the new interceptor sewer, and diversion facilities are shown on Plates 3 through 6. The Beaver Street pumping station was razed in 1982.

3. Damages Prevented

The method by which damages prevented (benefits) are computed is to compare actual observed flows with those that would have naturally occurred if upstream reservoirs had not been in place. The two most recent flooding events in the Merrimack River Basin were the storms of April and May/June 1984. For the latter event, the natural flows on the Merrimack River in Lowell were 90,000 cfs. The actual observed flow was only 57,000 cfs. Since flood damage in the area protected by the project would not start until the flow reaches 59,000 cfs, the reservoir system was credited with preventing all of the potential damages from that event. Of interest is the fact that along the right bank and the unprotected portion of the left bank of the river the existing system of upstream reservoirs prevented $9,900,000 worth of flood damage in Lowell from that same storm. The Lowell LPP itself has prevented nearly $1 million in flood damages since its construction.

In the April 1984 event the reservoirs reduced the computed natural flow from 64,000 cfs to an observed flow of 52,000 cfs. Once again the local protection project was not utilized since the flow was reduced below that at which damage starts. However the reservoirs were credited with $2,649,000 in flood damages prevented in the unprotected areas.

4. Level of Protection

The project was originally designed to provide one foot of freeborad above the record March 1936 flood as modified by the two reservoirs then under construction- Franklin Falls and Blackwater. The project presently provides about 4 feet of freeboard above the record March 1936 event, as modified by the now existing four reservoir system: Franklin Falls, Blackwater, Edward MacDowell and Hopkinton - Everett. Typical flood reductions on the Merrimack River provided by the existing reservoir system at Lowell is illustrated by the natural and modified stage-frequency curves shown on Plate 7. Reductions in discharges and stages that would be provided by the existing reservoir system in the recurrence of the major floods of March 1936 and September 1938 at Lowell are listed below.

TABLE 1
EFFECT OF EXISTING RESERVOIRS ON FLOODS OF RECORD

Event	Observed		Modified by 4 Existing Reservoirs	
	Discharge (cfs)	Elevation (ft NGVD)	Discharge (cfs)	Elevation (ft NGVD)
March 1936	173,000	73.6	112,000	65.0
September 1938	121,100	65.8	66,000	59.3

The March 1936 flood in Lowell has an estimated chance of annual occurrence approaching 0.5 percent. The LPP can presently provide protection against an event having a chance of occurrence annually of nearly 0.2 percent.

5. Recent Inspections

The most glaring and immediate problem with the existing project is the condition of the West Street Pumping Station. Due to lack of repair, the West Street Pumping Station is no longer capable of performing as a stormwater pumping station and only functions as a gravity overflow during storm events and low river levels. The city's sewer construction program of the 1970's incorporated the station into the new system as an overflow point, but did not include improvements at that time.

The pumps are inoperable because engine coolant froze and cracked the blocks of all the motors in 1979. These motors are obsolete and cannot be repaired - they must be replaced. In addition, the structure itself is not sound. The entire electrical system is aged and a safety hazard. The brick and block work of the building are beyond salvage due to water damage. The wet well has many open slab penetrations and represents a hazard.

The most recent semi-annual inspection was conducted on 18 October 84. A copy of the inspection report is included in the Appendix. The project, at that time, was in unsatisfactory condition. However, the City is working on a plan to rehabilitate the flood control system starting with the West Street Pumping Station. The consultant firm of Whitman & Howard, Inc. was recently requested by the City to recommend necessary rehabilitation action. This demonstrates the City's recognition of its obligation to properly operate and maintain the project.

B. Project Area

1. Description

The existing LPP intercepts both sanitary and storm runoff from a total drainage area of about 930 acres of moderately sloping urban residential area. The actual area being protected by the project includes an estimated 120 acres of industrial and residential property. Minimum ground surface elevations range from about 65 to 68 feet NGVD, or about 1 to 4 feet below the level of protection now afforded by the project against river flooding.

During the mid-thirties, some remedial work was completed by the WPA in the area, which is not considered part of the LPP. The main channel of the Merrimack River was straightened and lowered in several sections by removal of sandbars and the blasting and removal of ledge outcrops. The spoil, together with some borrow material, was placed in two areas to form dikes. The Beaver Brook dike starts at the Beaver Street bridge and extends 950 linear feet upstream along the right bank of Beaver Brook, with top elevation varying between 68 and 70 feet NGVD. The Rosemont Terrace dike starts at Beaver Street and extends upstream about 1,800 linear feet along the left bank of the Merrimack itself. The top elevation is about 74 feet NGVD. In order to give Beaver Brook a straighter entrance into the Merrimack River, a diversion channel was dug along the left bank adjacent to the Rosemont dike.

2. Land Use Changes

Much of the original low area along the landward side of the line of protection has been raised by the building and upgrading of the Veteran's Memorial Highway along the left bank of the Merrimack River. Therefore, an intense interior storm runoff in excess of storm sewer capacity, or pumping capacity during high river stages, would result in interior flooding to depths of 1 to 4 feet in localized low areas at the lower end of the drainage area. Without the pump station in operating condition, the interior flood damage potential is increased. Extensive cellar flooding could result from backup in the combined sanitary-storm system throughout the lower residential area, posing a considerable health in addition to flood hazard.

3. Hydrology and Hydraulics

Historic floods on the Merrimack River date back to 1875, but there is little factual information on these early events. In recent years four floods of major proportion were experienced in various parts of the Merrimack River basin. Two of these, November 1927 and September 1938, were associated with very intense rainfall; the March 1936 record event resulted from heavy rains in combination with snowmelt; a major flood in April 1960 was the result of basin snowmelt with moderate rainfall. Peak discharges as recorded at the US Geological gaging station on the Merrimack River at Lowell for these events are listed below:

TABLE 2

PEAK DISCHARGES
MERRIMACK RIVER
LOWELL, MASSACHUSETTS

Flood	Observed Discharge (cfs)
March 1936	173,000
September 1938	121,100
April 1960	79,000 *
November 1927	76,800

*Reflects the effects of the Corps upstream flood control reservoirs

Discharge-frequency curves for the Merrimack River at Lowell are shown on Plate 8. These curves represent natural and modified peak flow frequencies. The frequency analyses were made in accordance with procedures outlined in EM 1110-2-1450 and "Guidelines for Determining Flood Flow Frequency", which utilizes Log Pearson Type III distribution as the base method.

Since the great floods of March 1936 and September 1938, NED has constructed a system of four flood control reservoirs in the Merrimack River basin, which control flood runoff from 1,662 square miles or 36 percent of the watershed above Lowell. Typical modifications provided by these reservoirs at Lowell are illustrated by the natural and modified discharge-frequency curves shown on Plate 8. It is cautioned that for every occurrence of a certain frequency flood the reduction will not be exactly as indicated by the modified frequency curve. The magnitude of reduction will vary depending on the storm's orientation with respect to the upstream reservoirs.

A Standard Project Flood (SPF) has not been developed for the Merrimack River. A "project flood", which is almost identical in nature to the SPF, was included in the 1947 Report to the States. This synthetic

flood is derived from a storm "which would be exceeded only on rare occasions", and which incorporates the outstanding characteristics of the great storms of record over and in the vicinity of the basin. At the Lowell gaging station, natural discharge for this rare event would be 212,000 cfs resulting in a flood elevation of 79.5 ft NGVD. However, the existing reservoir system would modify this to 145,000 cfs and drop the flood elevation to 72.0 ft NGVD. A flood profile of the Merrimack River developed for the Federal flood insurance program in the vicinity of the LPP is shown on Plate 9.

III. FUTURE CONDITIONS

A. Land Use

1. Community Plans

A meeting with Mr. Robert Malovich, the city's Planning Director, and Mr. William Kealy of the City Manager's office included a discussion regarding future plans for the area being protected by the project. There is no master plan directing land development. Lowell is a very old community and planning is usually reactionary. Current zoning serves as an inventory of land use, both present and future.

2. Economics

The distribution of potential flood related losses among land use categories is in the following percentage: residential (70%), commercial/ industrial (25%) and public (5%). The Lakeview section, located along the left bank of the Merrimack River between the Aiken and Bridge St. Bridges, has a land use mix of rougly two-thirds residential and one-third commercial. The Rosemont section, located along Beaver Brook near its mouth with the Merrimack River, is nearly 100 percent residential. These percentages are reflective of a 1946 flood damage survey.

In conjunction with a 1962 study of proposed upstream reservoirs on the Merrimack River, the damage survey for the local protectin area in Lowell was updated to account for properties that were removed, new properties that were constructed and those that underwent significant change. In the intervening 16 years, 21 properties were removed and 14 were added. However those 14 that were added (6 residential and 8 commercial) were more than double the value of the 21 that were removed. Currently the area is maintaining on almost equal mix of commercial/retail and residential properties in Lakeview and nearby all residential in Rosemont.

Based on existing flood damage survey data, a recurrence of a flood of the magnitude of the March 1936 event, with no LPP or reservoir system in place would result in flood losses of $13,900,000 in the areas now protected by the Lowell LPP. The floodwaters would reach elevation 73.6 ft. NGVD. However, under existing conditions, the reservoir system

reduces flooding to elevation 65 ft. NGVD - completely eliminating such flood losses.

The Lakeview section is zoned for multi-family dwellings and local business. No significant new development is planned here. In fact, with the construction of the Lowell bypass (the Veterans of Foreign Wars Highway) through the area parallel to the Merrimack River there is not much remaining available land for development. The Rosemont section that is protected on the north side of Beaver Brook is zoned residential. This area is also nearly fully developed, with only a few lots still vacant. Lakeview and Rosemont can be located on Plate 1.

The University of Lowell would like to acquire the portion of Rosemont on the south side of Beaver Brook. This area is within the base floodplain and subject to restrictions of the National Flood Insurance Program requiring new construction to be set above the base flood elevation (1 percent chance of annual occurrence).

B. Project Integrity

The existing LPP has performed the intended purpose over its life to date. However, the semi-annual inspections have identified a number of deficient items that need to be addressed to ensure the project's performance. The wall and dike structures themselves are sound, and given proper maintenance should provide the intended protection well into the future. The West Street pumping station is inoperative and in urgent need of attention in order to prevent flooding from interior drainage.

The city of Lowell does have plans to rehabilitate and upgrade the West Street pumping station in accordance with both the Regional and Municipal Interceptor Program currently being implemented by the Commonwealth of Massachusetts' Department of Environmental Quality Engineering (DEQE) and the combined sewer overflow study being conducted by Whitman & Howard, Inc. These plans have been furnished to NED's Operations Division.

The LPP now provides a higher level of protection than its original design due to the construction of a comprehensive reservoir system in the upper reaches of the Merrimack River Basin. This fact implies that the LPP itself would be subject to fewer flood events and would be pressed into service less often. If proper operation and maintenance is accomplished, the project's integrity should not be diminished or threatened.

IV CURRENT PLANNING AND DESIGN CRITERIA

A. Freeboard

1. Requirements

There are no specified criteria with regard to the design level of protection for flood damage reduction projects. Each project should be complete within itself and provide the maximum net benefits, unless there is overwhelming justification to deviate. In urban areas the Standard Project Flood is a design goal since potential overtopping or failure could be catastrophic.

Engineering regulations call for freeboard allowances above design grade of 2 feet for concrete walls and 3 feet for dike or levee systems. With the existing system of reservoirs in the Merrimack River Basin, the Lowell LPP exceeds this criteria - given that its original design was to protect from a recurrence of the March 1936 flood of record. The level of protection now afforded by the project, to the top of wall (el 72.5 ft NGVD), approaches an event having a 0.2 percent chance of annual occurrence.

2. Economics

Current planning guidance allows for taking credit for expected benefits within the bottom half of the freeboard range. In the case of the Lowell LPP, this is not applicable since the elevation of the mid-point of the current freeboard is below the elevation where benefits were credited to when the project was originally planned.

EM 1120-2-104 outlines the procedure regarding benefits for advance replacement of existing projects. A credit can be taken for extending the life of a project and realizing benefits beyond which the project would have continued to function. Since the Lowell LPP is 40 years old and near the end of its economic life, any modification that extends its physical life may take advance replacement benefits. However, an engineering analysis of the structure's stability and integrity would have to be accomplished to determine just how much longer the LPP can perform its intended purpose since advance replacement benefits can only be attributed for the period of time after that.This study does not address this issue.

V MODIFICATION OPPORTUNITIES

A. Level of Protection

Opportunities to increase the level of protection of the Lowell LPP are limited. Previous discussion reflected the ability of the project with regard to the existing design grade. Since the project now actually provides protection to an event rarer than originally intended, raising

the height of the floodwall is unnecessary. Also, from an economic standpoint development in the area being protected does not warrant additional protection at this time. Many of the buildings originally afforded protection are vacant, under less intense use, or have been removed.

B. Protected Area

Inspection of the areas downstream and upstream of the LPP indicated extension of the existing measures are not needed at this time. The Merrimack River's banks at these locations are substantially higher than potential flood stages and only a few structures would be provided new flood protection.

C. Project Features

As discussed earlier, the West Street Pumping Station is in urgent need of rehabilitation. The capability of the existing large interceptor sewer, plus any planned modifications to it in the near future, is an important consideration in the review of pumping station capacity requirements at the West Street facility. However, determining an appropriate pumping capacity cannot be entirely analytical, but must be a combination of both quantitative and subjective analysis.

The sizing of a station must be weighed against the flood risk based on both frequency and magnitude of potential damages. Some hydrologic factors to be considered in assessing pumping station requirements are:

- Frequency and duration of high river stages that require pumping.
- Likely coincidence of interior rainfall-runoff and high river stage.
- Interior watershed size and runoff potential.
- The interior flood damage potential in human life and property.

A guide chart relating possible design discharge criteria to flood damage potential, frequency of high river stage, and rainfall-river stage coincidence is shown on Plate 10.

The frequency and duration that a river's stage is above the stage necessary for gravity discharge is an indicator of the need for pumping. The greater the frequency and duration of high stage, the greater the chance of interior rainfall occurring during that high river stage. This is a measure of risk based on probabilty of occurrence alone, and is an important consideration in combination with other factors such as the magnitude of potential damage.

As estimated stage-frequency curve for the Merrimack River opposite the West Street facility is shown on Plate 7. Prior to the construction

of the large interceptor sewer, pumping was required when the river reached or exceeded about elevation 58 feet NGVD, which has about a 20 percent yearly chance of occurrence. However, under present conditions, with the interceptor sewer in place, needed pumping would be less frequent and would be required when the river exceeded 58 feet NGVD only if the interceptor was malfunctioning or its capacity was being exceeded. The probability of the above occurring during high river stage cannot be determined precisely, but not likely more than a 5 to 10 percent chance of annual occurrence event, at most. Therefore, in regard to the guide chart shown on Plate 10, the frequency of required pumping at West Street, under present conditions, is judged to be in the "low to medium" category.

A second consideration is the probable coincidence of intense local rainfall-runoff during high river stage, and in the case of West Street, the likelihood of the coincident runoff exceeding the interceptor sewer capacity. With protection projects on small flashy rivers it is quite probable that interior rainfall will occur during high river stage, both resulting from the same storm system. However, on larger rivers with increasing times of concentration, interior rainfall during high river stages would be less probable and more likely the result of a secondary storm system rather than that associated with the initial runoff event. Considering the likely coincidence of the two events is again a relative measure of risk based on "probabilities" rather than "possibilities" of occurrence.

The Merrimack River stage at Lowell would be less responsive to short duration high-intensity rain storms, and high stages would be more the result of large volume rainfall from stationary or slow moving storm systems. High stages would, however, be more likely the result of storm systems over the lower part of the basin, that portion of the watershed not controlled by upstream reservoirs. These would be the type of systems producing local interior rainfall. Therefore, the coincidence of interior rainfall with high river stage at Lowell is judged in the "medium" category in regard to the guide chart shown on Plate 10.

The primary factor in determining interior runoff potential is the size and character (topography and development) of the interior watershed. In addition, the peak rate of runoff to a pumping station from a relatively flat urbanized watershed can be highly affected and limited by the design capacity of storm drainage systems in the area. The West Street station was initially sized using runoff rates based on a 10 percent annual chance rainfall, resulting in a flow of 286 cfs. This was then reduced to 240 cfs, the capacity of the incoming sewers. The finally adopted design was 340 cfs, as suggested by the Office of the Chief of Engineers, to provide backup capacity. For the present, hydrologic review, runoff rates and frequencies were estimated on an analysis of peak discharge frequencies from small gaged streams in the general region with allowance made for the effects of urbanization.

The West Street station's watershed (shown on Plate 11) is quite highly urbanized with approximately half in the city of Lowell, which is a moderately sloping and completely storm sewered. The other half is in the steeper northern neighboring town of Dracut, Massachusetts. The storm water from Dracut enters Lowell as open channel flow where it is intercepted in a conduit and conveyed to the West Street station.

An important consideration in assessing present West Street pumping requirements, both in magnitude and frequency, are the capacities of the combined sanitary storm sewers at the station - both the original sewers draining to the station and the new interceptor sewer capacity, both entering and leaving the site.

The estimated capacity of the original storm drains leading to West Street station is 240 cfs. The new interceptor sewer, both incoming and leaving the West Street facility has an approximate capacity of 120 cfs. In regard to the "guide chart" shown on Plate 10, the flood damage potential in the West Street interior area is judged "low to medium".

Therefore, the system serving the West Street area should be equipped with, at a minimum, an emergency gravity discharge to the Merrimack River (under normal stage) capable of not less than 360 cfs - the capacity of the incoming storm sewers (240 cfs) plus the interceptor (120 cfs). Also, based on the considerations discussed and the guide chart shown on Plate 9, provision for a 50 percent chance of annual occurrence storm runoff from the Lakeview watershed (110 cfs) under high river stages would not be unreasonable. Such nongravity discharge would have to be handled by pumping or some other means. The required pump capacity would therefore be 110 cfs minus any inflow-outflow difference of the interceptor.

In the design of flood control pumping stations, it is recommended using no fewer than two pumps and that each be sized so that two-thirds of required capacity can be provided with one pump out of operation.

VI CONCLUSIONS

An increased level of flood protection or extension of the protected area at the Lowell LPP is not needed at this time. The LPP's walls and dikes are in good condition. However, the West Street pumping station is in urgent need of attention. The project is currently capable of providing protection against an event having an annual chance of occurrence of nearly 0.2 percent, or that with a recurrence interval of 500 years. There is about four feet of freeboard above the design level - the record March 1936 event.

VII RECOMMENDATIONS

A. Modification Advisability

Modifications to increase the level and extent of flood protection at the Lowell LPP are not recommended at this time. However, due to the project's age another review in accordance with EC 11-2-147 should be scheduled. The LPP will be 50 years old in 1994. This would be an appropriate time for the next review.

B. Operation And Maintenance

It is imperative that the city of Lowell continue to recognize its responsibility to properly operate and maintain the project. If there is any further delay in repair of the West Street Pumping Station by the city of Lowell, it is recommended that Operations Division, NED pursue an immediate solution to bring the LPP back to a satisfactory condition.

ER 1130-2-339 outlines the process to be taken. Assistance from the Commonwealth of Massachusetts can be requested. The necessary work could be contracted out by the state and billed to the city of Lowell, or state aid funds held back as payment. The project's unsatisfactory condition should be made a matter of public knowledge. Use of mass mailing, or the press, are suggested. If the city of Lowell does not bring the project back to satisfactory condition within an appropriate time frame, assumption of maintenance responsibilities by the Commonwealth of Massachusetts is recommended.

VIII CORRESPONDENCE

December 7, 1984

Operations Division, Project Operations Branch

Mr. B. Joseph Tully
City Manager
City Hall
Lowell, Massachusetts 01852

Dear Mr. Tully:

My representatives conducted the semi-annual inspection of the federally constructed local flood protection project in Lowell, Massachusetts on October 18, 1984. I have enclosed a detailed inspection report for your review.

Although the project remains in unsatisfactory condition, I am aware that you are working on a plan to modify and upgrade the City's flood control system. I also understand that you are waiting to repair the West Street Pumping Station. We will be happy to review your plans for remedial work. In the meantime, I urge you to see that the concrete repairs and tree removal mentioned in the report be accomplished. Left uncorrected, these items can lead to a malfunction in the floodwall system, and can therefore result in flood damage to the city.

I want to thank Mr. Corey and Mr. Defillippo of your staff and Mr. Levine and Mr. Parise of Whitman and Howard Inc. for the courtesy extended to my representatives during the recent inspection. Should you have any further questions, please contact me at (617) 647-8220 or James Morocco of my staff at (617) 647-8291.

Sincerely,

Enclosure
as stated

Carl B. Sciple
Colonel, Corps of Engineers
Division Engineer

Copy furnished:

Mr. Edward J. Tierney
Deputy Commissioner
Water Dept.
City Hall
Lowell, MA 01852

Mr. George LeGrant Jr.
Commissioner of Public Works
City Hall
Lowell, MA 01852

Mr. Arthur Corey
Maintenance Operator
City Hall
Lowell, MA 01852

Mr. Carmen Defillippo
Process Control Engineer
Lowell Waste Water Treatment Facility
Lowell, MA 01852

Basin Manager, MDR

LOCAL FLOOD PROTECTION PROJECT INSPECTION REPORT

Project: Lowell, MA LPP

Maintaining Agency: City of Lowell, MA

Type Inspection: X Semi-Annual Staff ____ 90 Day Interim

River Basin: Merrimack Date of Inspection 18 Oct 1984

Feature	Sat	Unsat	Deficiencies
PUMPING STATIONS - STRUCTURES			See Comment #1
INTERIOR		X	
EXTERIOR		X	
PUMPS - MOTORS - ENGINES			See Comment #1
TRIAL OPERATED		X	
GENERAL CONDITION		X	
POWER SOURCE		X	
INSULATION TESTS		X	
METAL INTAKES/OUTLETS		X	
GATE VALVES		X	
GATES - DRAINAGE STRUCTURES			See Comment #1
TRIAL OPERATED		X	
GENERAL CONDITION		X	
LUBRICATION		X	
DIKES - DAMS			
GENERAL CONDITION	X		See Comment #2
SLOPES/EROSION	X		
SAND BOILS/CAVING	X		
TRESPASSING	X		
SLOPE PROTECTION	X		
DRAINS	X		
STOP-LOGS - LOG BOOM			
CONDITION OF LOGS	X		
AVAILABILITY OF LOGS	X		
HIGHWAY SLOTS	X		
STORAGE FACILITIES	X		
CHANNELS - OUTLET WORKS CHANNEL			
BANKS	X		
OBSTRUCTION CONTROL	X		

NED FORM JAN. 66 513

Feature	Sat	Unsat	Deficiencies
CONCRETE STRUCTURES			
SURFACE	X		
SETTLEMENT	X		
JOINTS		X	See Comment #3
DRAINS	X		
MISCELLANEOUS			
EMERGENCY OPER. PLAN			
EMERGENCY EQUIPMENT			
SEMI-ANNUAL REPORT			

Inspection Party: Mr. Arthur Corey, Lowell Wastewater Treatment Pland
Mr. Garmen Defillippo, Process Control Engineer
Mr. Tom Parise, Whitman & Howard Inc.
Ms. Jan Levine, Whitman & Howard Inc.
Ms. Kate Higgins, Park Ranger, MRB
Mr. Edward McCabe, Assist. Project Manager, Hopkinton Lake
Mr. J.A. Ward, Basin Manager, MRB

Photographs Taken:

None

Remarks & Additional Comments:

(Indicate Here Observations, Discussions, Specific Feature Deficiencies, Recommendations and any other pertinent information. Use Continuation Sheet if necessary.)

Comment #1 - No remedial work has taken place at the West Street Pumping Station.

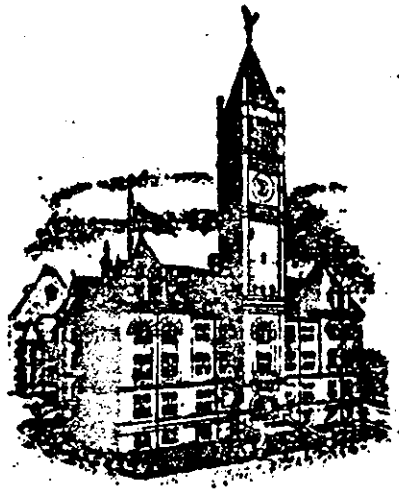
Comment #2 - More brush and tree growth needs to be removed from along floodwall in the vicinity of Beaver Street Stop log Structure.

Comment #3 - Copper water stop in floodwall needs repair.

X ALL APPLICABLE ITEMS. IF UNSAT INDICATE SPECIFIC DEFICIENCIES. INDICATE IF NOT APPLICABLE.

DATE	INSPECTED BY: TYPED NAME & TITLE	SIGNATURE
10/26/84	J.A. WARD, Basin Manager, MRB	J.A. Ward

JAMES J. CAMPBELL
ASSISTANT CITY MANAGER
OPERATIONS
CHARLES R. MATTHEWS
ASSISTANT CITY MANAGER
ADMINISTRATION



B. JOSEPH TULLY
CITY MANAGER

(617) 454-8821

OFFICE OF THE CITY MANAGER
CITY HALL
LOWELL, MASSACHUSETTS 01852

September 11, 1984

Massachusetts Division of Water Pollution Control
Department of Environmental Quality Engineering
One Winter Street
Boston, Massachusetts 02108

Attn: Mr. Mark Casella

Gentlemen:

As previously discussed with your office by our engineering consultants (W&H, VTN), both by letter and verbally, and by our wastewater treatment plant management personnel, the City is faced with a serious problem in the "North Bank Interceptor-West Street Pump Station system. To summarize this problem, the City has no means of reliable flow control at this structure to regulate combined sewage flow to the treatment facility and/or the river. This is due to two factors; 1) the present condition of the West Street Pump Station (out of service) and 2) to the use of manually actuated sluice gates on the newly constructed North Bank Interceptor. The results of this problem have been damage to the manholes, rip-rap and metering station of the Interceptor and the discharge of large volumes of combined sewage to the river. The solution to this problem is the rehabilitation of the West Street Pump Station to perform the automated functions of a diversion station. More specifics with regard to the problem(s), the solution(s) and the cost of this work are attached.

In order for the City to proceed with the necessary work to re-condition the West Street Pump Station in a timely and cost-effective manner, we need to request direction from your office on several specific issues. Your evaluation and response on the following points is requested:

1. Can the City issue a change order to an on-going contract to provide automatic operation of the sluice gates at West Street? If so, which contract?

2. Can the City utilize anticipated, excess grant monies (from the current interceptor work) to fund the design and construction of a new diversion facility at West Street?

3. If existing grant funds can not be utilized, will the Division favorably receive a request for a planning advance to fund the design of the new facilities at West Street?

4. If the planning advance route is selected, what portion of the total project (as recommended by W&H in the CSO study) will be required to be included (Re-conditioning West Street? - Brook Separation? - CSO Treatment?). What would be the mechanism to obtain construction funding as soon as possible?

At this time, the City has authorized Whitman & Howard, Inc. to complete the CSO facilities plan as soon as possible. The basic recommendations for the West Street Pump Station have been extracted from the draft of this study and are included in the attachments. The final draft is expected to be submitted to your office by mid-October.

Your immediate attention to this serious problem is greatly appreciated, in order that we may alleviate the situation before spring flooding (sluice gates) and correct the overall problem at West Street prior to the completion of the new interceptor extension and the addition of 25 MGD of combined sewage into an overtaxed system. We await your response and direction.

Very truly yours,

B. Joesph Tully
City Manager

BJT/tmj
82-022

GEORGE P. LEGRAND, JR.
COMMISSIONER OF PUBLIC WORKS

ROY GOODENOUGH
EXECUTIVE MANAGER/PRINCIPAL SANITARY ENGINEER

The City of

LOWELL, MASSACHUSETTS

Wastewater Treatment Facility

FIRST ST. BLVD. (RT. 110) LOWELL, MA 01850
617-458-0071

August 7, 1984

Stephen Poole
Whitman & Howard
45 Williams St.
Wellesley, MA. 01821

Dear Mr. Poole:

As discussed on July 31, 1984, after our meeting with DEQE concerning upgrading of the West Street Station, the following is provided as an indication of how the condition of the West Street Station makes the station a danger to the facility and the interceptor up-stream of the station.

Our immeadiate concern is that there is no reasonable means of controlling flow through this structure. I have attached a copy of a letter from myself to Ivan Von Szilassy of VTN concerning the situation with the control gates. As indicated in the letter this condition is dangerous and cannot wait for the rehabilitation of the entire structure. It is requested that the proposal made to DEQE include provisions for the City to proceed immeadiately with the gate modifications, so that the treatment facility and interceptor are protected. If the city proceeds with the gate operator modifications, it is hoped that the money spent would be eligible for reimbursment. A request for direction as to how to proceed with the gate work should also be included in the proposal. After talking with Rodney Hunt, the original supplier of the gates, it appears that gate operators and Hydraulic Systems to operate one gate now and the remaining gates in the future would cost approximately seventy-five thousand dollars.

If you have any questions or require more detail please do not hesitate to contact me.

Sincerely yours,

Robert Coolidge,
Plant Engineer

Lowell File

VTN CONSOLIDATED, INC.

77 North Washington Street
Boston, Massachusetts 02114

P.O. Box 8126
Telephone: (617) 227-6666

INFO

May 31, 1984

Mr. Thomas C. McMahon, Director
Department of Environmental Quality Engineering
Division of Water Pollution Control
One Winter Street
Boston, Massachusetts 02108

Attn: Mr. Glen Haas

Re: FY 85 State/EPA Priority List

Dear Mr. McMahon:

On behalf of the City of Lowell, Massachusetts, VTN Consolidated wishes to submit this request for inclusion on the Fiscal Year 1985 Priority lists for Planning and Construction. The subject project is an integral part of the Regional and Municipal Interceptor Sewer Program currently being implemented. The objective of this request is to increase the current grant for planning and construction to include the rehabilitation of the West Street Pump Station/Diversion Structure.

The need for this rehabilitation is critical. At present, public health and safety and water quality are adversely impacted. Rehabilitation of the West Street Pump Station was originally intended to be part of the initial interceptor work. In short, it was delayed several years ago so that it might be incorporated into the Combined Sewer Overflow Study being conducted by Whitman & Howard Inc. Regardless of which program this project is studied/evaluated under, it is imperative that this work proceed as quickly as possible so that the integrity of the interceptor system can be completed and assured. As you see in the attached report by the Army Corps of Engineers, dated April 24, 1984, the work on this pump station is required. Further, with moderate wet-weather flows, certain upstream manholes have been damaged due to surcharging in the lines.

While the station's obsolete and damaged pump drive units replacement is necessary, the modification of the 96 inch sluice gate on the 96 inch interceptor from manual to automatic operation is urgent. Presently, the gate replaces some function of the pumps by acting as a flow control to the Duck Island Treatment Plant. The Plant's influent pumps are, at the time being, operating considerably below their capacity which in turn requires above average gate operation. According to the attached letter from the City of Lowell, the frequent manual operation of the gate is not just impractical, but, in some instances, impossible.

The old pump station operated with 2 gates to divert the excess flow either to the river or to the wetwell of the station without a flap gate at its outfall.

An 84 inch manually operated sluice gate, on the old pump station side of the new structure, which should be closed only during the maintenance of the pumps, is used to prevent the river water from entering the interceptor and the Treatment Plant. The gate is closed during high river elevation in the spring and fall rainy seasons.

The 96 inch gate to the Treatment Plant can be opened a controlled amount (4"-5") only. It must be closed completely during heavy rainfall to protect the Plant's pumps. When both gates are closed, the interceptor flow is trapped within the system. The resulting back up has, in the past, damaged the 96 inch interceptor as well as the metering station at the Dracut Town Line. According to the Treatment Plant personnel, such a back up, on some occasions, has occurred within 15 minutes and, as past experience indicates, creates approximately 20 ft. of head. As a result, the station platform, where both gate operators are located, is flooded and the fast rising water level makes the hand operation hazardous.

From the above reasoning, VTN Consolidated, Inc. concurs with the request of the City to install a flap gate at the existing outfall and modify the 96 inch sluice gate to an automatic one. The flap gate would prevent the river water from entering the Treatment Plant and would eliminate the need of operating the sluice gate to the old pump station. It would also reduce, but not eliminate, the back up in the interceptor system during high river elevation. It would not eliminate the frequent and timely operation of the 96 inch sluice gate to the Treatment Plant.

The City would ideally wish to proceed with this project in two phases, simultaneously. Adding the flap gate and modifying the 96 inch sluice gate needs to be done immediately to alleviate the flooding problems. Rehabilitating the pump station must also be done. While urgent, the need is not as immediate as the former.

We hope you find our reasoning has some merit and you can assist the City in funding this long outstanding and costly problem. Estimated cost for the design and construction is approximately $600,000.00

If your response is positive, in principal, we will proceed with formal Grant Application and the preparation of contract documents. Also, we are available to discuss in depth the status of the current projects as they pertain to this matter.

Attached are - The City's request to proceed with the installation of a flap gate and modification of the 96 inch sluice gate.
- A drawing indicating the positions of the existing gates.
- Letter from the Army Corps of Engineers in regard to the West Street Pump Station.

If you need any further information, please contact the undersigned.

Sincerely yours,

VTN CONSOLIDATED, INC.

William V. Chisholm, P.E.
General Manager

WVC/IVS/js
ATTACHMENTS

cc: Mr. William Kealy, Special Projects Coordinator - Lowell
Mr. R. Coolidge, Plant Engineer - Duck Island Treatment Plant
Army Corps of Engineers

Mr. Jackson
114-N

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

May 16, 1984

REPLY TO
ATTENTION OF:
Planning Division
Plan Formulation Branch

Mr. B. Joseph Tully
City Manager
City Hall
Lowell, Massachusetts 01852

Dear Mr. Tully:

I have initiated a review of the existing Lowell local flood protection project, completed by the Corps of Engineers in 1944. This project, like others we are studying in New England, was designed and constructed many years ago using design criteria in effect at that time. Our study will include a review of the adequacy of flood protection currently provided by the project, recent and possible future development in the watershed and new information on basin hydrology. We will also be looking for opportunities to make the project more viable, safe and reliable using current design standards.

Initially the study will be limited to a reconnaissance report which will evaluate the need for any modification to the completed project and determine whether there is a Federal interest in continuing the investigation. If warranted, I may recommend a follow-on feasibility study. During the feasibility study stage any modification plans will be formulated using current design criteria and screened from the standpoints of economics, environmental effects, engineering integrity and safety considerations. Items of local cooperation, both existing and those required for the future, will also be addressed if further action is recommended.

This study is not a substitute for the semi-annual inspections performed by my Operations Division personnel. Those inspections are conducted to ensure that the city is complying with the assurances of local cooperation signed by the city prior to construction of the Lowell project. The reconnaissance study will utilize previous semi-annual inspection reports and correspondence with the city as background information and will identify existing and potential problems previously observed which should be reviewed as part of this study. A member of my Planning Division staff participated in the semi-annual inspection of the Lowell project on April 24, 1984.

Your comments are vital to our study. In the near future, a member of my staff will be contacting you, or a point of contact you appoint, to set up a meeting to discuss our study and hear your viewpoints. If you have any questions or comments please do not hesitate to call me at (617) 647-8220. Mr. Richard Zingarelli will be managing the study. He may be reached at (617) 647-8557.

Sincerely,

Carl B. Sciple
Colonel, Corps of Engineers
Division Engineer

cc:
Mr. Swaine
Mr. Jackson
Mr. Minior
Reading FIle
Plan Div Files

LEGRAND, JR
COMMISSIONER OF PUBLIC WORKS

ROY GOODENOUGH
EXECUTIVE MANAGER/PRINCIPAL SANITARY ENGINEER

The City of

LOWELL, MASSACHUSETTS

Wastewater Treatment Facility

FIRST ST. BLVD. (RT. 110) LOWELL, MA 01850
617-458-0071

May 11, 1984

Ivan Von Szilassy
VTN Consolidated Inc.
77 North Washington Street
P.O. Box 8126
Boston, MA 02114

Dear Ivan:

Due to the fact that both the interceptor leading into the West Street Structure, and the Bachman Street metering station, have suffered damage due to lack of control and pumped diversion at West Street, the city of Lowell intends to rehabilitate the West Street diversion station and associated control gates. Since the rehabilitation of the diversion station will be an involved contract and, therefore, require more time to complete that is practical in correcting the flow control needs, it is intended to separate the gate control work necessary to afford protection to the treatment facility and interceptor, from the diversion station and to proceed immediately on the gate control work. The following is a description of the gate work which must proceed now.

There are presently four gates at the west street location, one gate controls flow to the treatment facility and the remaining gates are used to divert excess flow either to the river or the diversion station. Since there is presently no means of pump diversion, two of the gates serve no purpose and the third is used to regulate flow to the river and prevent river water from entering the interceptor during periods of high river level. The gate to the facility is a manually operated gate in a dangerous location. When the gravity diversion gate to the river is closed to prevent river water from entering the interceptor, it also prevents excess from any sudden increase in interceptor flow from releaving into the river. When this occurs, the interceptor becomes damaged with no means of dumping excess flows and has in the past damaged both the interceptor and metering station.

In order to both protect the facility and prevent damage due to changing the interceptor, the following work must be accomplished.

1. Install a flap gate on the gravity diversion box culvert headwall. This will allow excess flow from the interceptor to enter the river without having the river flow into the interceptor during periods of high river elevation. In cases of high river elevation the interceptor will have to build up untill it overcomes the river elevation. This will be the minimum elevation necessary to gravity divert to the river.

2. Install necessary operator, piping, electrical, instrument and hydraulic equipment to operate at least the plant flow sluice gate. Options for hydraulic operator are listed below.

   a) Manual lever type hydraulic valve to operator one sluice gate.

   b) Manual valve with position indication from sluice gate indicating precent sluice gate is open.

   c) Manual valve or electric push button operator for local operation. Local position indication with 4-20 MA output for remote gate position indication. Position controller capable of positioning gate at a desired position using a remote 4-20 MA gate position signal.

In all cases, necessary accumulator capacity shall be provided to move the gate full open or closed, and also a hand operated hydraulic pump in case of sustained loss of power.

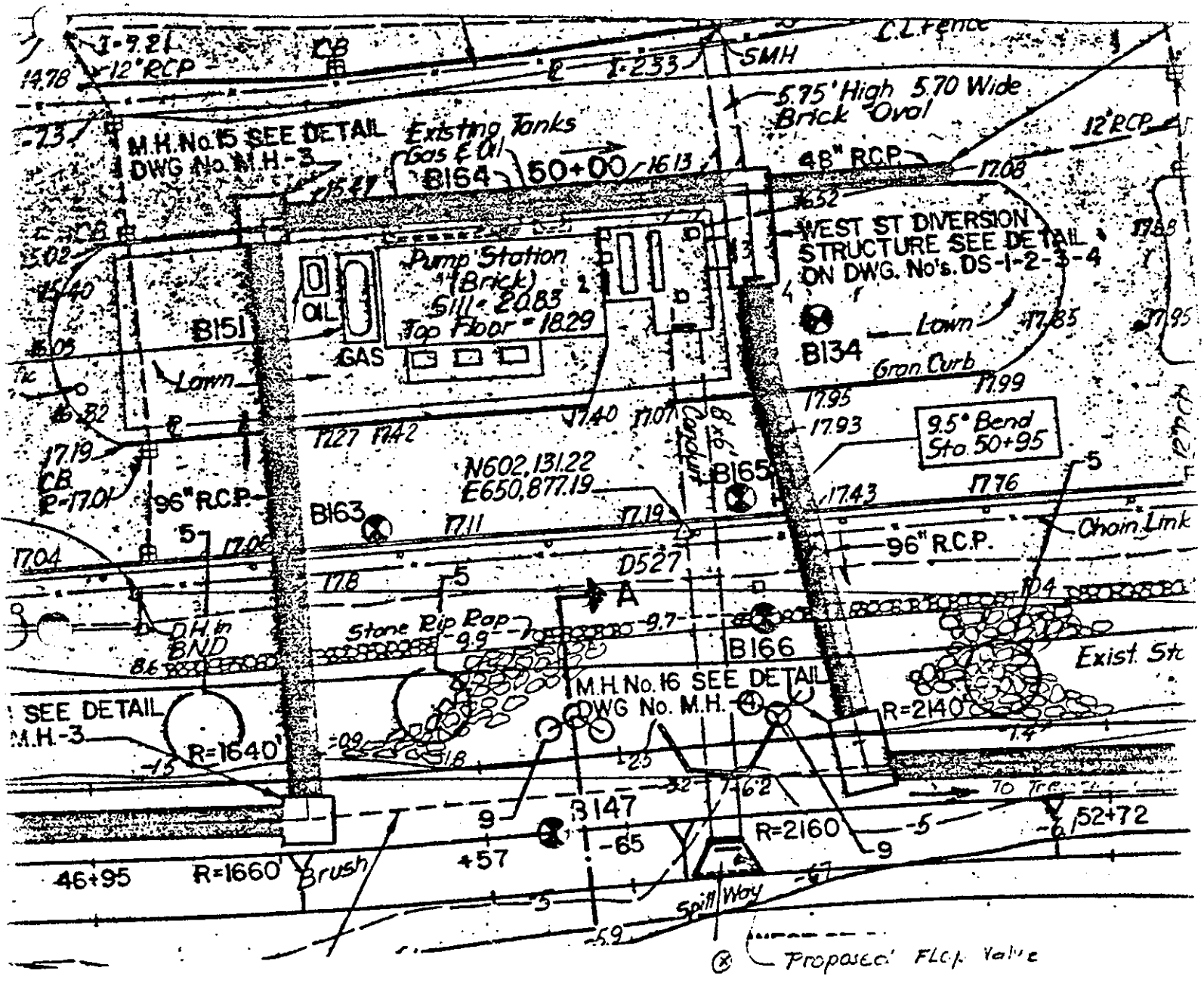
Though only one sluice gate will be provided with a hydraulic operator at the point in time, the upgrading of the diversion station will require that at least two gates are retrofitted in the future. It is, therefore, requested that the hydraulic power pack and necessary controls be sized and estimates be provided for operating from one to four gates of approximately the same size as the existing gate to be retrofitted. This would allow for a larger capacity hydraulic power pack to be provided if it was determined that the capacity would be built in now rather than scrap a unit that will be to small in a few years. The capacity would be built into the hydraulic power system only. Operators and controls, both manual and automatic, would be provided at the time the gates are retrofitted.

Sincerely

Robert A. Coolidge
Plant Engineer

RC/dd

cc: William Kealy, Special Projects Coordinator
Roy Goodenough, Executive Manager/Principal Sanitary Engineer



SLUICE GATE Nº 1 Old, obsolete electrical, operated gate. It work, but uncertain.

Nº 2 Old, obsolete gate not usable.

Nº 3 Manualy operated new gate, presently is used to prevent the river water entering the system.

Ⓜ Nº 4 Manual operated new gate, presently is used to control the interceptor flow to the Duck Island Treatment Plant

Ⓜ Subject of installation or modification

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

IN REPLY REFER TO:

NEDOD-R

PROJECT INFORMATION SHEET

PROJECT: Merrimack River LOCATION: Lowell, Massachusetts

MAINTAINED BY:

DIKES yes (4) RETAINING WALLS yes (2) PUMPING STATION yes (2)

GATES yes (3) STOP LOGS yes (1) CHANNELS none

CRIB WORK none MISCELLANEOUS none

PROTECTION PROVIDED: Protects 120 acres of industrial and residential property.

ADJUSTED COST: $3,984,000 (1964)

DATE COMPLETED: June 1944

MAINTAINING AGENCY:

AGENCY City of Lowell

ADDRESS City Hall, Lowell, Massachusetts TEL. NO. 454-8821

"SUPERINTENDENT" - (as required by Section 208.10 (A)(2), Chap II, Title 33)

NAME & TITLE Mr. Edward J. Tierney

ADDRESS 381 Douglas Road, Lowell, Massachusetts TEL. NO. 454-8821, Ext. 374

EMPLOYED BY City of Lowell, Water Department

SIGNED _____

TITLE _____

DATE _____

Whitman & Howard, Inc. est. 1869 inc. 1924
45 William Street, Wellesley, Massachusetts 02181-4050, Telephone (617) 237-5000

WHI

May 7, 1984

Mr. William Kealy
Special Projects Coordinator
City Manager's Office
City Hall
Lowell, Massachusetts 01852

RE: Lowell, Massachusetts

Dear Mr. Kealy:

Enclosed please find a brief summary of our recommendations for the rehabilitation of the West Street Pumping Station. As you requested, we have provided you with a written description of the anticipated work required to make this station operational for storm water diversion purposes. We have also included the requirements for adding facilities to treat the diverted combined sewage and stormwater as developed in our on-going CSO facilities plan. A third recommendation dealing with the separation of two brooks from the existing combined sewer system is also included for your consideration.

Whitman & Howard, Inc. would be pleased to submit a detailed proposal for the design of any or all phases of the project at your request. We have been informed by the Division of Water Pollution Control that a planning advance for this work can be submitted separately from the CSO aspect of the overall City system. This planning advance could and should address all three recommendations addressed, regardless of the final decision to build or not to build any or all of the project. The City should be able to receive 90% funding for the planning advance and for the work to follow as CSO related work in Lowell is high on the FY 84 priority list.

Should you wish to review the attached summary report, please contact this office. We are available on request to supplement the summary report for submittal to the State DWPC if you should decide to proceed with the project.

Very truly yours,

WHITMAN & HOWARD, INC.

Stephen E. Poole, P.E.
Project Manager

SEP:mag
cc: R. Goodenough
R. Coolidge
82-022

WEST STREET PUMPING STATION

LOWELL, MASSACHUSETTS

The West Street Pumping Station (WSPS) was designed and built by the Corps of Engineers in the early 1940's in response to the flooding of the Merrimack River during the severe storms in 1936 and 1938. Due to the combined sewer nature of the Lowell sewer system, a structure such as the WSPS is necessary to prevent the river from flooding basements during periods of high water. As a result of minimal use and lack of maintenance, the WSPS is no longer capable of performing as a stormwater pumping station and only functions as a gravity overflow during storm events and low river levels.

The City's sewer construction program of the 1970's incorporated the WSPS into the new system as an overflow point but did not include improvements to the station at that time. The on-going "Combined Sewer Overflow Facilities Plan" for the City of Lowell addresses the needs of the WSPS with regard to both pumped overflow capacity and treatment of the bypassed combined sewage flows. The following summarizes these recommendations in an abbreviated form:

1. The WSPS is no longer functional as a stormwater pumping station due to the age of the facility and the damage to the equipment resulting from a loss of heat during the winter. This situation caused the pump engine coolant to freeze and crack the blocks of all the motors. As

the type of gasoline driven engines are no longer manufactured, it is impossible to repair this damage. In addition, the structure of the WSPS is severely deficient from a code point of view. The entire electrical system should be abandoned due to the hazards of the system. Also, the brick and block work of the building are beyond salvage due to water damage. These should also be replaced to improve the insulating quality of the structure. The location of the wet well below the first floor slab with many open slab penetrations is also a code violation due to the potential hazard atmosphere of a wet well. It appears that the structural aspects of the building could be salvaged including the roof, structural steel roof supports and the below grade structure. Mechanically, the pumps, engine drives, bar screen and gates should all be sold as scrap. The newly added overflow chamber is reusable with modifications to the manually operated sluice gates, electrical work and addition of functional flow and level measurement systems.

2. The reconstructed WSPS should serve the dual purpose of stormwater pump station and combined sewer overflow treatment facility. This can be accomplished by reconstructing the existing facility and the addition of a new building adjacent to the WSPS to house rotating

screens and disinfection facilities. The reconstruction of the WSPS should involve the following items:

a. Modifications to the new and old overflow structures to include automatically activated sluice gates, a bar screen, level and flow measurement devices;

b. Modifications to the existing wet well area to yield a separate below grade wet well and dry well area. The installation of a new series of dry pit, variable speed controlled centrifugal sewage pumps to direct flow to either the rotating screens or directly to the river. Addition of a ventilation system for the below grade areas with an odor scrubber system;

c. Reconstruction of the above grade structure to include a new insulated block and brick wall utilizing insulated light transparent panels. Addition of waterproofing to the roof with new roof drain facilities. Possible addition of a solar hot water heating system. A new HVAC system for the above ground building. A new electrical system for both building and mechanical system purposes as well as standby power generation; and

d. Construction of a new building to the north of the existing facility to house a below grade chlorine detention basin and an above grade sewage screening

facility. This building should be equipped with the appropriate electrical and HVAC systems as well as an odor control system.

3. Construction of a new pipeline to carry the flow of two brooks which presently enter the existing combined sewer system. The flow from these brooks is generated primarily in Dracut and should be diverted around the WSPS and into the Merrimack River.

The actual task of accomplishing the above listed recommendations can be phased or constructed simultaneously depending on City, State and Federal resources. The need to accomplish this work has been demonstrated in the last two years where a combination of high river flows and intense rainfall events has resulted in flooding of the North Bank Interceptor resulting in damage to the Bachman Street metering station and the loss of one interceptor manhole and associated damage to the rip-rap along the river.

COST ESTIMATE

Based on the recommended improvements to the WSPS the following can be used as a budget for the design of the work and the eventual construction of the entire system:

Design of Systems

1.	West Street Pump Station Rehabilitation	$ 150,000.00
2.	Combined Sewer Overflow Addition	78,000.00
3.	Brook Separation	28,000.00
4.	Contingencies @ 10% of 1, 2 and 3	25,600.00
	TOTAL	$ 281,600.00

Construction Facilities

1.	West Street Pump Station	$3,420,470.00
2.	Combined Sewer Overflow Addition	4,425,000.00
3.	Brook Separation	2,637,400.00
4.	Engineering Supervision	525,000.00
5.	Contingencies @ 5% (of 1,2,3 and 4)	550,000.00
	TOTAL	$11,557,870.00

The basis of the construction cost is described in the CSO facilities plan but in general is based on the cost curves developed for the facilities plan. During design, the actual volume of flow to be treated in the CSO portion of the project versus the volume to be discharged with only chlorination must be determined to set the actual project scope. The estimates shown above reflect complete treatment of the total flow. Any change to this will effect the total project construction costs in a downward manner. The estimates for design are based on actual recommendations versus the cost curve numbers shown in the facilities plan and therefore are considered to be reasonably reflective of the project cost.

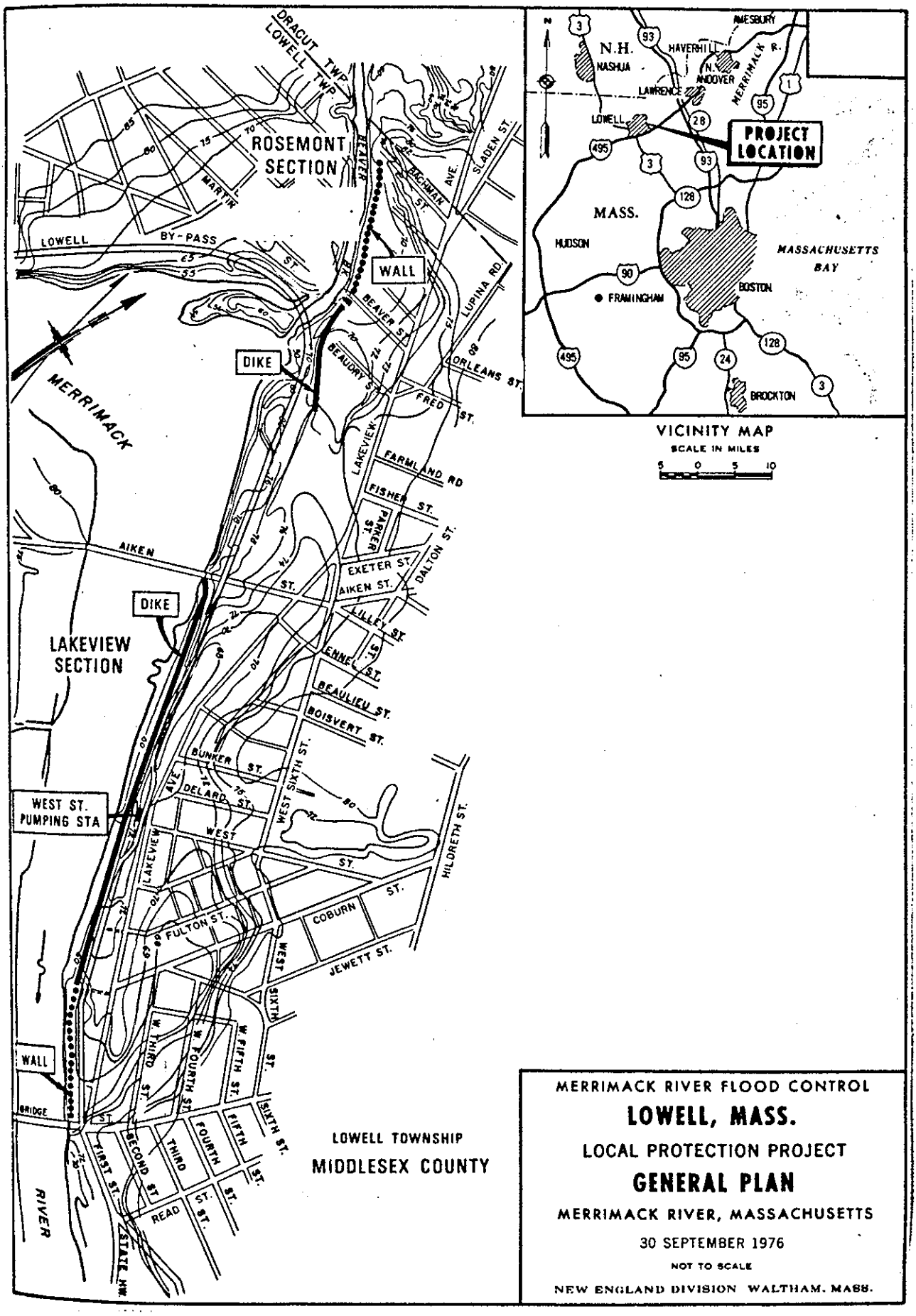

DRACUT
LOWELL TWP
LOWELL TWP
ROSEMONT SECTION
MERRIMACK
LOWELL BY-PASS
MARTIN
BEACHMAN AVE.
SLADEN ST.
WALL
BEAVER ST.
LUPINA RD.
ORLEANS ST.
DIKE
BEAUDRY ST.
FRED ST.
LAKEVIEW
FARMLAND RD
FISHER ST.
PARKER ST.
DALTON ST.
AIKEN ST.
EXETER ST.
LILLEY ST.
DIKE
LAKEVIEW SECTION
BEAULIEU ST.
BOISVERT ST.
BUNKER HILL AVE.
DELARD ST.
WEST SIXTH ST.
HILDRETH ST.
WEST ST. PUMPING STA
LAKEVIEW
WEST ST.
COBURN ST.
FULTON ST.
JEWETT ST.
WEST SIXTH ST.
WALL
BRIDGE ST.
W. THIRD ST.
W. FOURTH ST.
W. FIFTH ST.
SIXTH ST.
FIRST ST.
SECOND ST.
THIRD
FOURTH
FIFTH ST.
READ ST.
STATE HWY
RIVER
N
3
93
N.H.
NASHUA
HAVERHILL
AMESBURY
N. ANDOVER
MERRIMACK R.
LAWRENCE
1
95
LOWELL
28
PROJECT LOCATION
495
3
93
128
MASS.
HUDSON
MASSACHUSETTS BAY
90
FRAMINGHAM
BOSTON
128
495
95
24
BROCKTON
3
VICINITY MAP
SCALE IN MILES
5 0 5 10
LOWELL TOWNSHIP
MIDDLESEX COUNTY
MERRIMACK RIVER FLOOD CONTROL
LOWELL, MASS.
LOCAL PROTECTION PROJECT
GENERAL PLAN
MERRIMACK RIVER, MASSACHUSETTS
30 SEPTEMBER 1976
NOT TO SCALE
NEW ENGLAND DIVISION WALTHAM, MASS.

PLATE 1

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY

LOWELL TOWNSHIP

MIDDLESEX COUNTY

DRACUT TWP.
LOWELL TWP.

ROSEMONT SECTION

BEAVER BROOK

WALL

DIKE

BEAVER ST. PUMPING STATION
(FORMER STATION SITE)

MERRIMACK

DIKE

LAKEVIEW SECTION

WEST ST. PUMPING STATION

WALL

STATE HWY NO 110

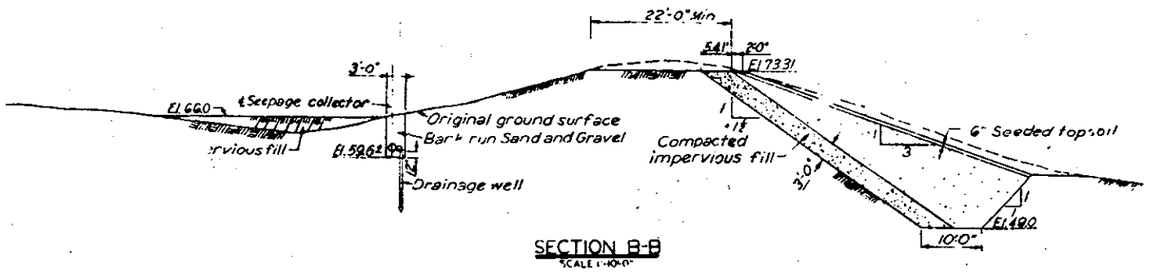
RIVER

CONCORD R.

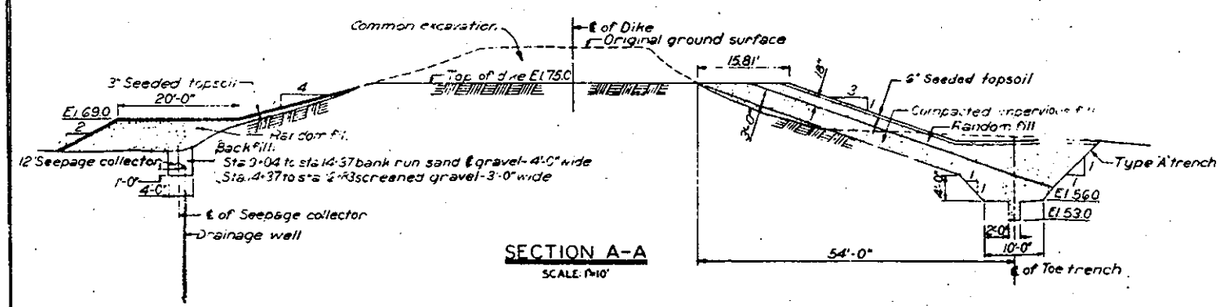
STACKPOLE ST.

INDEX MAP

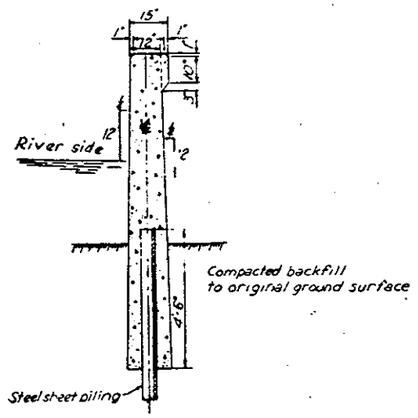
VT.
ME.
MASS.
OCEAN
ATLANTIC
Lowell
Boston



SECTION B-B
SCALE 1"=10'-0"



SECTION A-A
SCALE 1"=10'



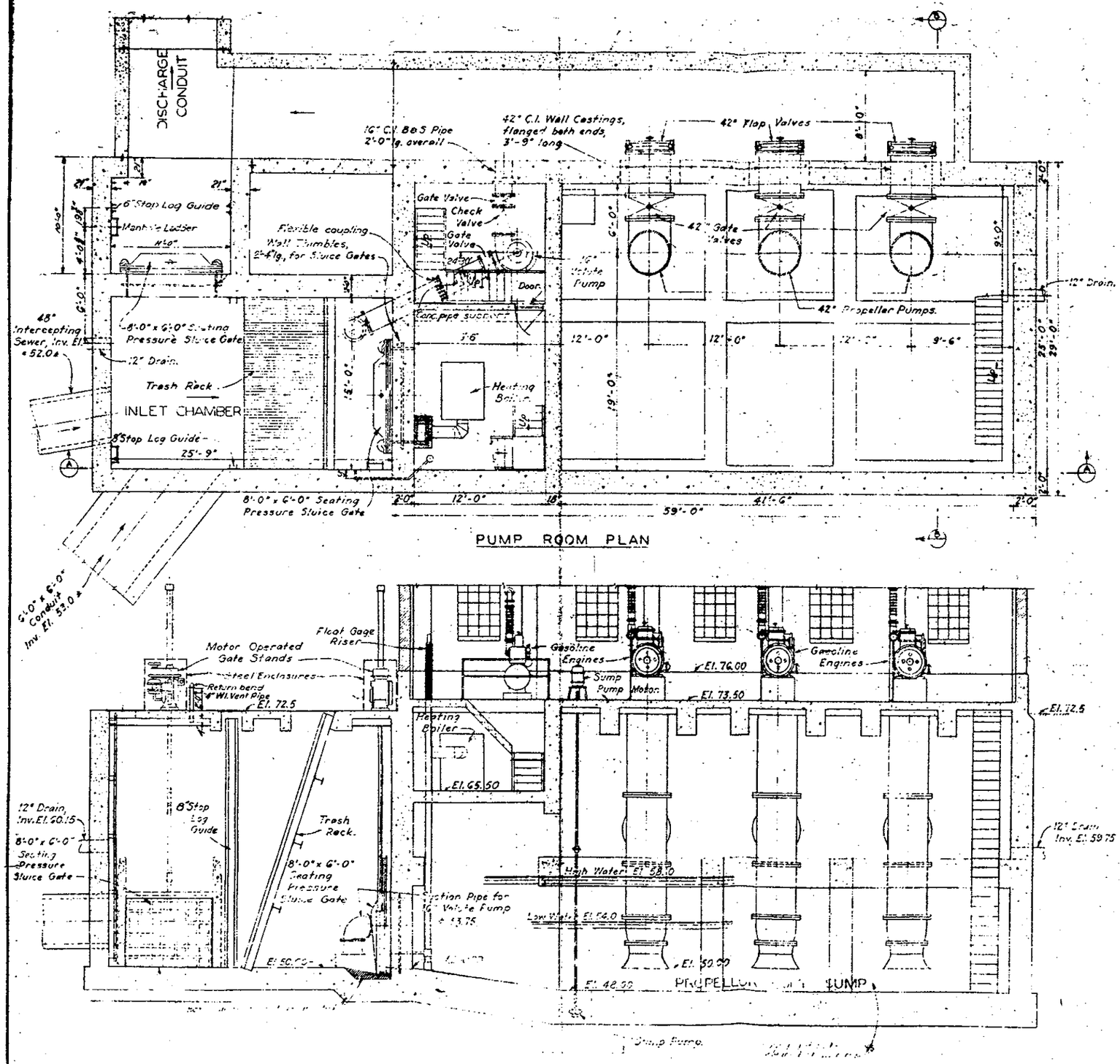
SECTION C-C
SCALE 1/2"=1'-0"

LOWELL LOCAL PROTECTION PROJECT

HYDROLOGIC REVIEW OF INTERIOR DRAINAGE

GENERAL PROJECT PLAN AND TYPICAL SECTIONS

PLATE 2



LOWELL LOCAL PROTECTION PROJECT

HYDROLOGIC REVIEW OF INTERIOR DRAINAGE

ORIGINAL WEST ST. PUMPING STATION GENERAL PLAN AND SECTIONS

PLATE 3

NOTE: EXISTING RIP-RAP THAT IS DISTURBED DURING CONSTRUCTION SHALL BE REPLACED AT NO ADDITIONAL COST

REPLACE FENCE AS DIRECTED

LAKEVIEW AVE.

VFW HIGHWAY

EXACT LOCATION OF THE EXISTING SEWER LINE, PROPOSED SEWER LINE AND THE PROPOSED TYPE B MANHOLE TO BE DETERMINED IN THE FIELD

TBM M-10 NE Cor. Stone Bnd Elev = 1800

Pin in Lead Plug in MH Bnds

PROPOSED UNDER GROUND STORAGE TANKS SEE DETAIL DWG. FT-1

Existing Tanks Gas & Oil

Pump Station (Brick) Sill = 2083 Top Floor = 1829

WEST ST DIVERSION STRUCTURE SEE DETAIL ON DWG. No's. DS-1-2-3-4

M.H. No. 15 SEE DETAIL DWG No. M.H.-3

M.H. No. 14 SEE DETAIL DWG No. M.H.-3

M.H. No. 16 SEE DETAIL DWG No. M.H.

TBM M-10 @ Gran. Bnd Elev = 1800

Edge of Existing Rip-Rap

Edge of River

Woods Extends Into River About 100 Feet ±

Exist Stone Rip-Rap

Stone Rip-Rap

Chain Link Fence

Chain Link Fence @ Back Sidewalk

Guard Rail

Bell Over Pipe

Existing 48" Sewer Approximate Location

Gran. Curb

Traffic Sign

Lawn

C.L. Fence

Edge of River 3/26/75

Soundings Taken 6/13/75

Soundings Taken 6/13/75

APPROX. TOP SLOPE

LIMIT BERM

LIMIT OF CONTRACT 7A

TOE SLOPE PAVING

APPROX. TOE DUMPED RIP-RAP

WHICHEVER CONTRACTOR (7A OR 7B) IS AT STATION 57+00 LAST, SHALL BE RESPONSIBLE FOR THE PIPE JOINT.

BERM, SLOPE, & RIP-RAP SHALL RUN CONTINUOUS BETWEEN STA. 47+53 AND 52+08 AS SHOWN IN TYPICAL SECTION MINUS PIPE.

SECTION SEE DWG. CS-2

WEST ST. OUTFALL SEE DETAIL ON DWG. No. O-1

MERRIMACK RIVER

1st Bend Sta 44+68 N602,367.20 E650,566.32

4" Bend Sta. 54+50 N601,871.44 E651,102.43

95° Bend Sta 50+95

N602,488.60 E650,447.20

N602,286.08 E650,722.99

N602,131.22 E650,877.19

N601,963.91 E651,043.77

N601,845.55 E651,161.61

N601,766.70 E651,153.43

N601,697.78 E651,203.27

N 602,500

E 650,600

N 601,800

E 651,400

E 650,400

E 651,200

N 601,600

MATCH LINE DWG. No. PP-4

PIPE TO BE JACKED SEE SPECIFICATIONS

DIVERSION STRUCTURE

PIPE TO BE JACKED SEE SPECIFICATIONS

M.H. No. 14

M.H. No. 15

M.H. No. 16

APPROX. EXISTING GROUND

PROPOSED FINISHED GRADE +5.83

PROPOSED FINISHED GRADE +5.68

96" R.C. Sewer

APPROX. EXISTING GROUND

TOE SLOPE PAVING -3.46

TOE SLOPE PAVING -3.60

APPROX EXISTING GROUND

Slope = .00025

Slope = 00025

℄ 96"-1° Hor. Bend

℄ 96"-95° Hor. Bend

℄ 96"-4° Hor. Bend

Inv. -7.03

Inv. -7.12

Inv. -7.16

Inv. -7.18

Inv. -7.98

Inv. -8.02

44+00 44+68 47+52 47+70 48+65 49+15 50+38 50+73 50+98 50+95 51+92.5 52+07 54+50

NOTE:
ELEVATIONS ARE LOWELL DATUM WHICH IS 55.2 FT. ABOVE N.G.V.D.

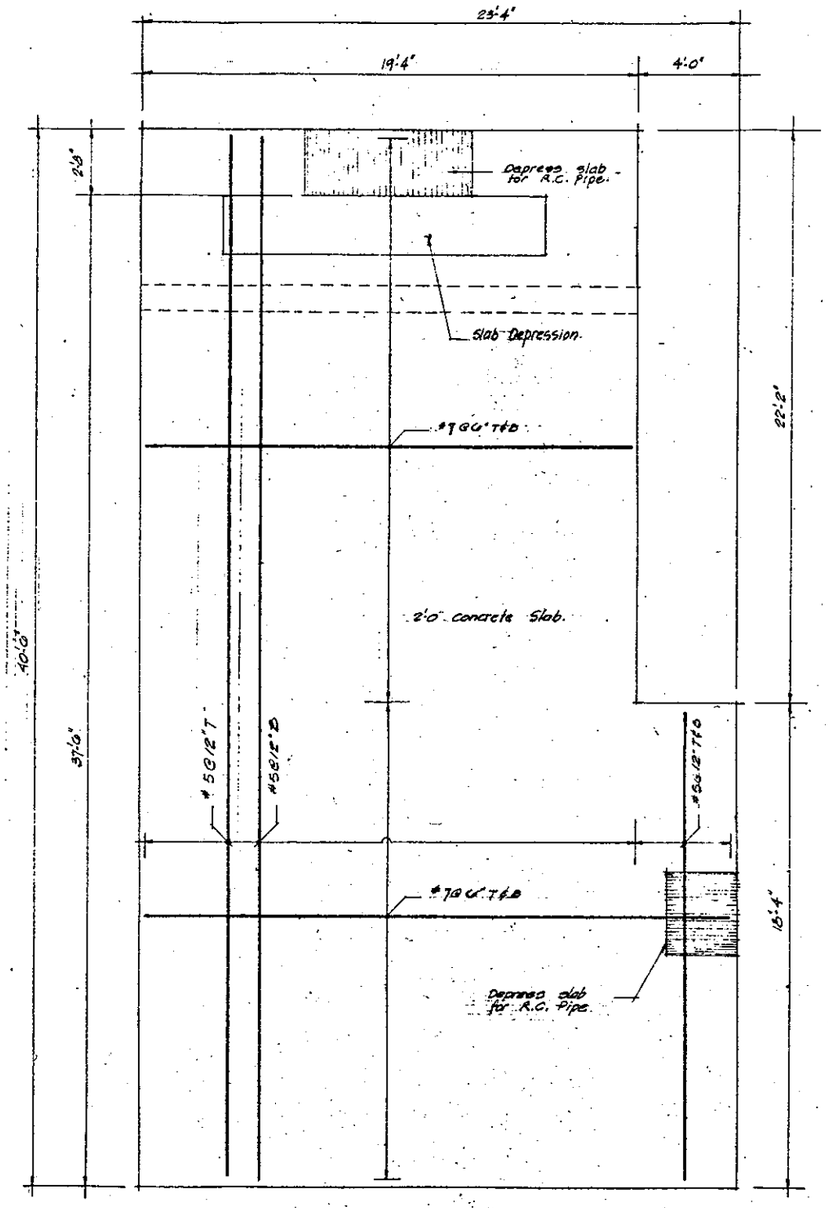
LOWELL LOCAL PROTECTION PROJECT
HYDROLOGIC REVIEW OF INTERIOR DRAINAGE
NEW 96 INCH INTERCEPTOR SEWER
AT WEST ST. PUMPING STATION
PLAN AND PROFILE
BY
VTN CONSOLIDATED INC.

DATE	REVISIONS	REVISED BY	CHECKED BY

DESIGNED BY S.C.
DRAWN BY B.C.
CHECKED BY H.G
APPROVED BY S.R.

VTN CONSOLIDATED INC.
77 NORTH WASHINGTON STREET
BOSTON, MASS.

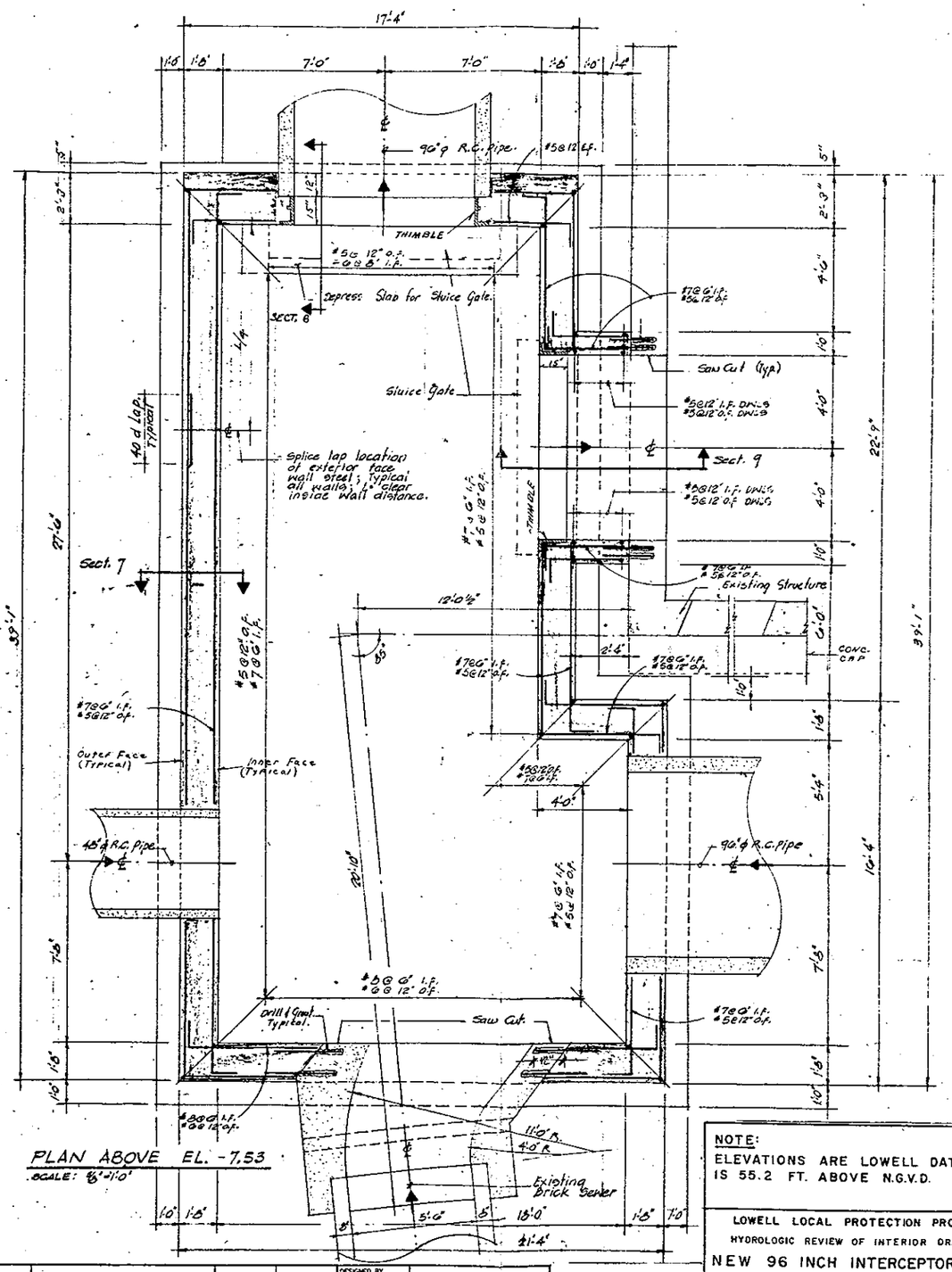
PLATE 4



PLAN ABOVE EL. -7.53 (MAT SLAB)
SCALE: 3/8"=1'-0"

NOTE: SEE DWG. NO. PE-1 FOR GENERAL NOTES.

N



PLAN ABOVE EL. -7.53
SCALE: 3/8"=1'-0"

NOTE:
ELEVATIONS ARE LOWELL DATUM WHICH IS 55.2 FT. ABOVE N.G.V.D.

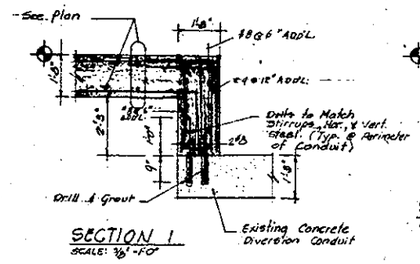
DATE	REVISIONS	REVISED BY	CHECKED BY

DESIGNED BY C.M.P.
DRAWN BY G.M.A.
CHECKED BY C.E.B.
APPROVED BY S.R.

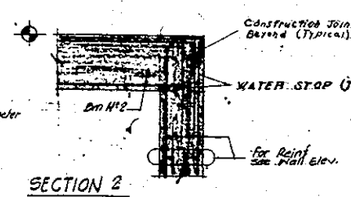
VTN CONSOLIDATED INC.
77 NORTH WASHINGTON STREET
BOSTON, MASS.

LOWELL LOCAL PROTECTION PROJECT
HYDROLOGIC REVIEW OF INTERIOR DRAINAGE
NEW 96 INCH INTERCEPTOR SEWER
PLAN OF DIVERSION STRUCTURE
AT WEST ST. PUMPING STATION
BY
VTN CONSOLIDATED INC.

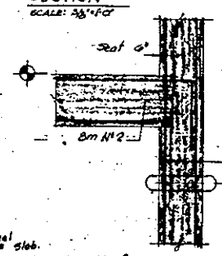
PLATE 5



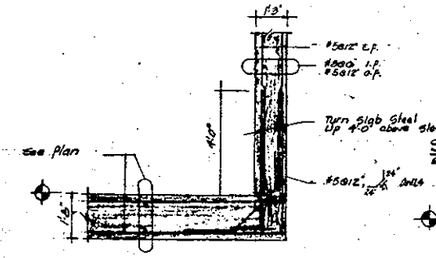
SECTION 1
SCALE: 3/8"=1'-0"



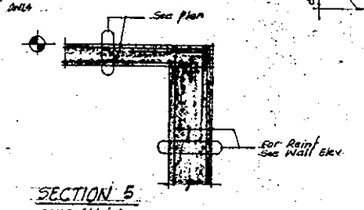
SECTION 2
SCALE: 3/8"=1'-0"



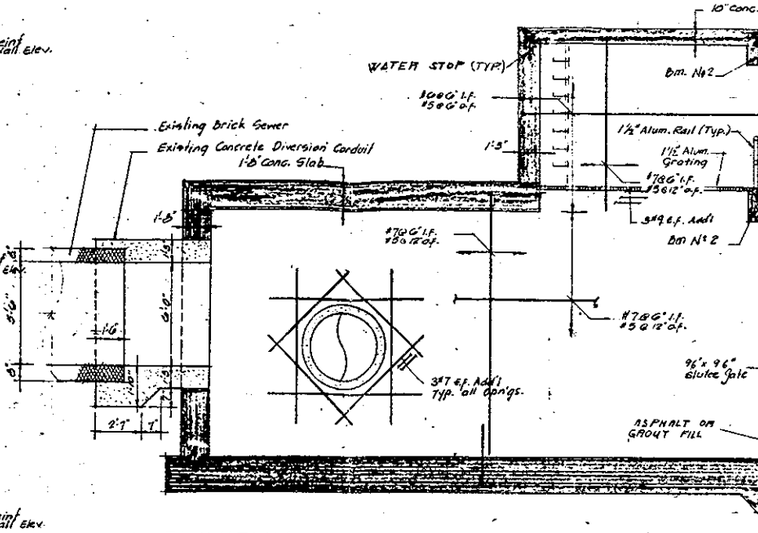
SECTION 3
SCALE: 3/8"=1'-0"



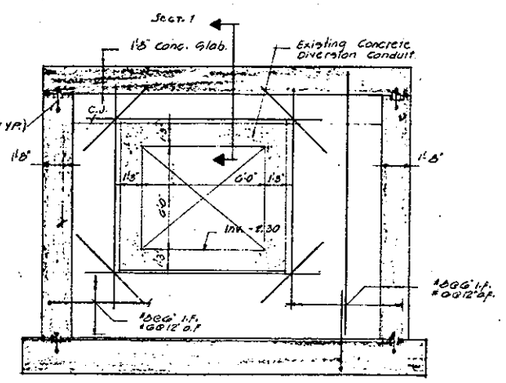
SECTION 4
SCALE: 3/8"=1'-0"



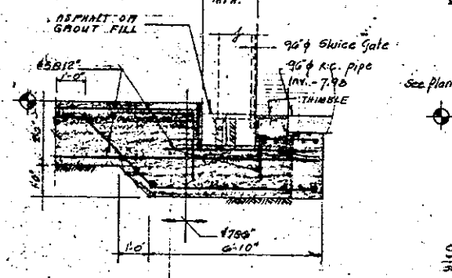
SECTION 5
SCALE: 3/8"=1'-0"

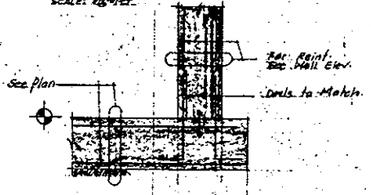


ELEVATION 1
SCALE: 1/4"=1'-0"

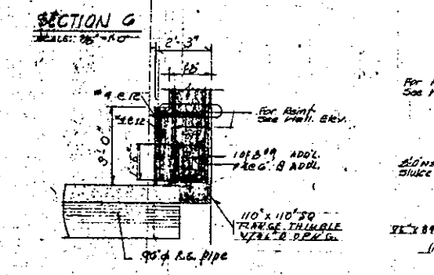


ELEVATION 2
SCALE: 1/4"=1'-0"

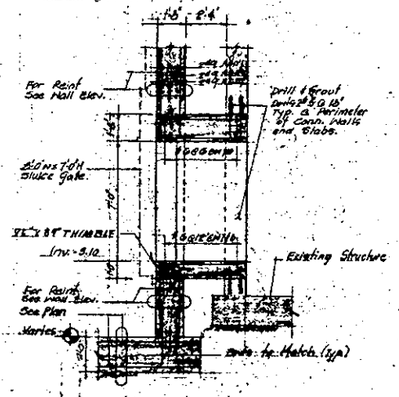




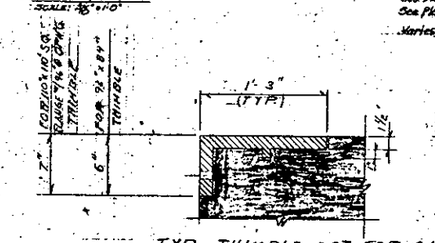
SECTION 7
SCALE: 3/8"=1'-0"



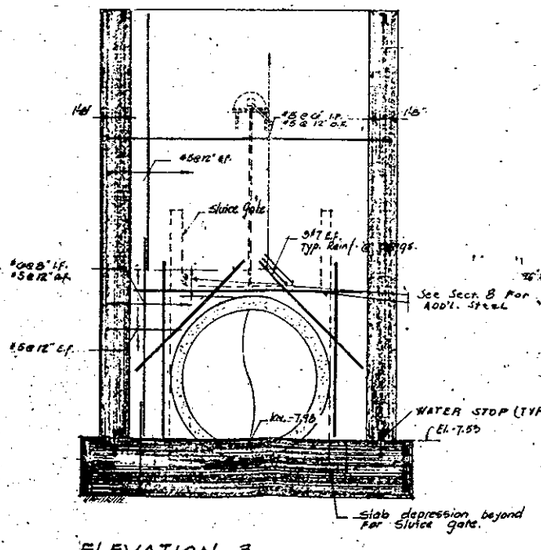
SECTION 6
SCALE: 3/8"=1'-0"



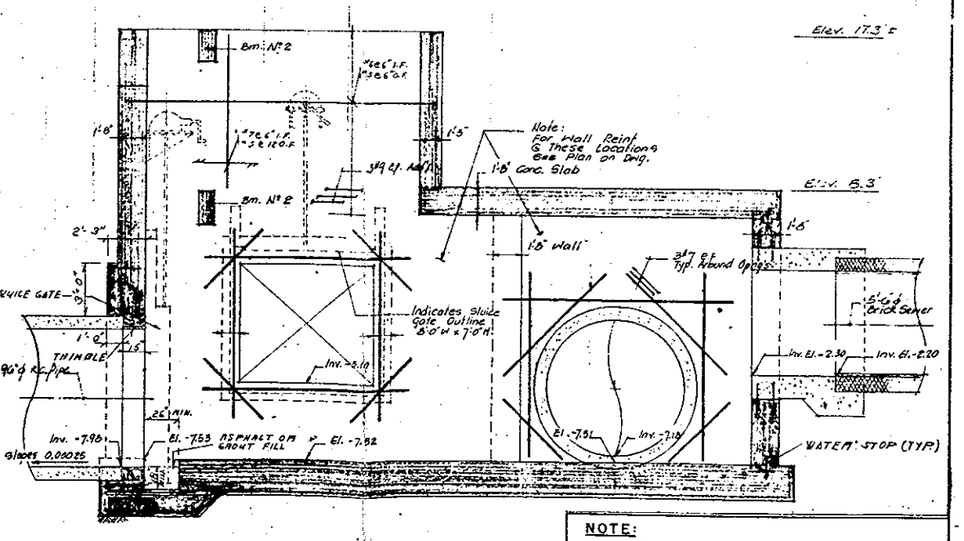
SECTION 9
SCALE: 1/4"=1'-0"



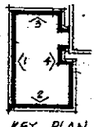
TYP. THIMBLE DET. FOR GATES
SCALE: 1½"=1'-0"



ELEVATION 3
SCALE: 1/4"=1'-0"



ELEVATION 4
SCALE: 1/4"=1'-0"



KEY PLAN
N.T.S.
(N°) : Indicates Wall Elevation No.

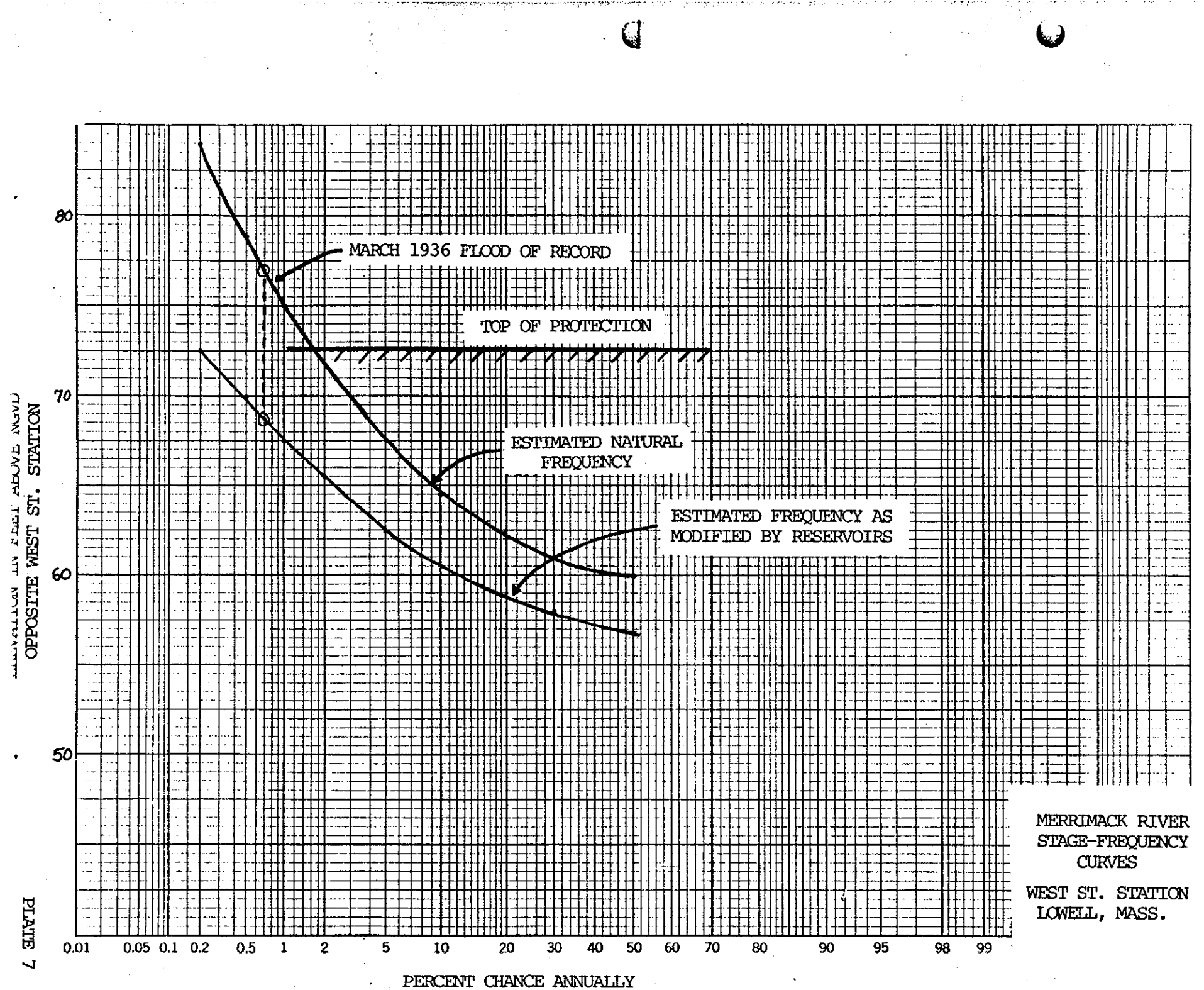
NOTE:
ELEVATIONS ARE LOWELL DATUM WHICH IS 55.2 FT. ABOVE N.G.V.D.

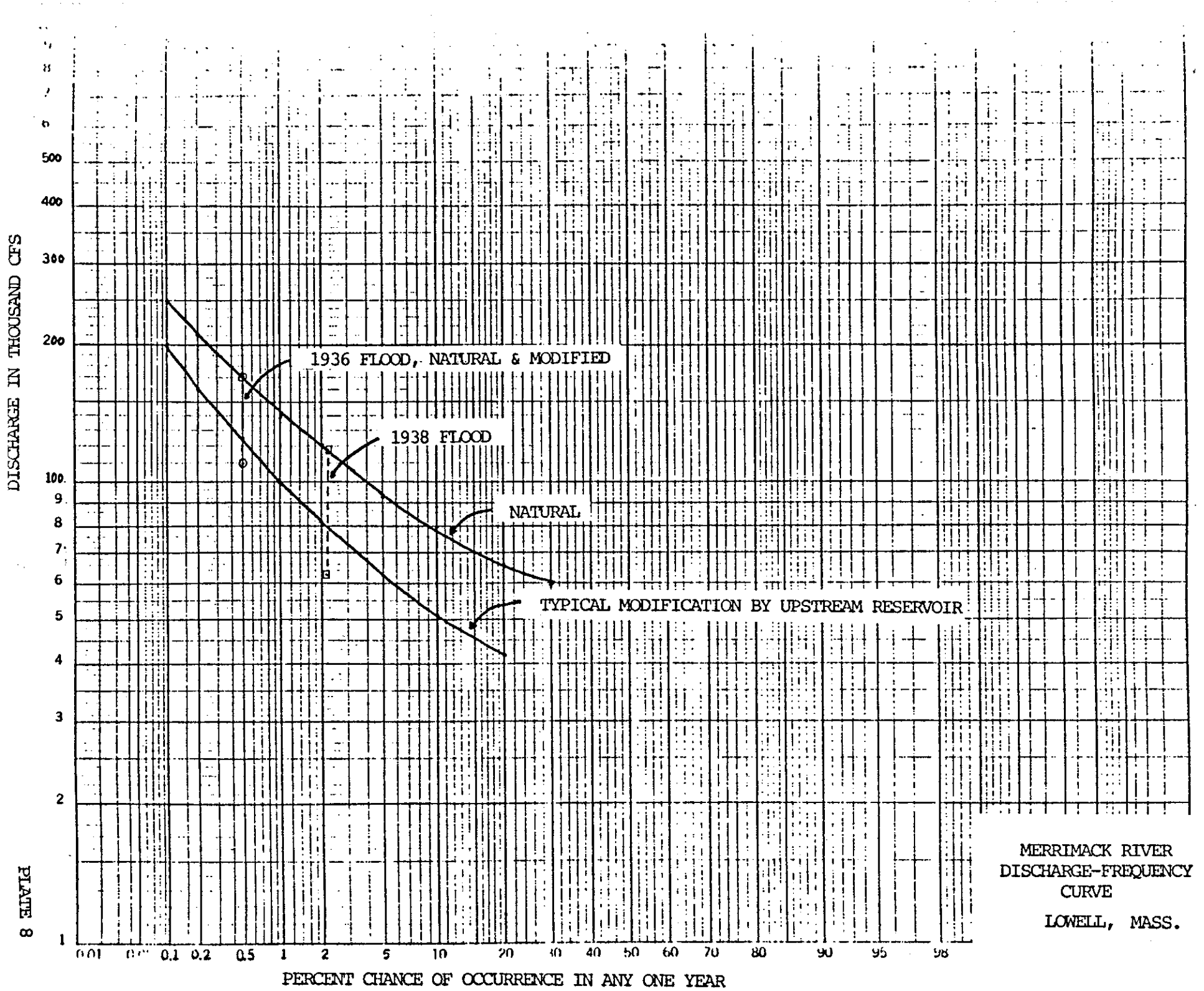
DATE	REVISIONS	REVISED BY	CHECKED BY

DESIGNED BY C.M.P.
DRAWN BY G.M.A.
CHECKED BY C.E.B.
APPROVED BY S.R.

VTN CONSOLIDATED INC.
77 NORTH WASHINGTON STREET
BOSTON, MASS.

LOWELL LOCAL PROTECTION PROJECT
HYDROLOGIC REVIEW OF INTERIOR DRAINAGE
NEW 96 INCH INTERCEPTOR SEWER
DIVERSION STRUCTURE SECTIONS
AT WEST ST. PUMPING STATION
BY
VTN CONSOLIDATED INC.


ELEVATION IN FEET ABOVE MSVD
OPPOSITE WEST ST. STATION
80
70
60
50
MARCH 1936 FLOOD OF RECORD
TOP OF PROTECTION
ESTIMATED NATURAL FREQUENCY
ESTIMATED FREQUENCY AS MODIFIED BY RESERVOIRS
0.01 0.05 0.1 0.2 0.5 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99
PERCENT CHANCE ANNUALLY
MERRIMACK RIVER
STAGE-FREQUENCY
CURVES
WEST ST. STATION
LOWELL, MASS.
PLATE 7


DISCHARGE IN THOUSAND CFS
500
400
300
200
100
9
8
7
6
5
4
3
2
1
1936 FLOOD, NATURAL & MODIFIED
1938 FLOOD
NATURAL
TYPICAL MODIFICATION BY UPSTREAM RESERVOIR
0.01
0.1
0.2
0.5
1
2
5
10
20
30
40
50
60
70
80
90
95
98
PERCENT CHANCE OF OCCURRENCE IN ANY ONE YEAR
MERRIMACK RIVER
DISCHARGE-FREQUENCY
CURVE
LOWELL, MASS.
PLATE 8

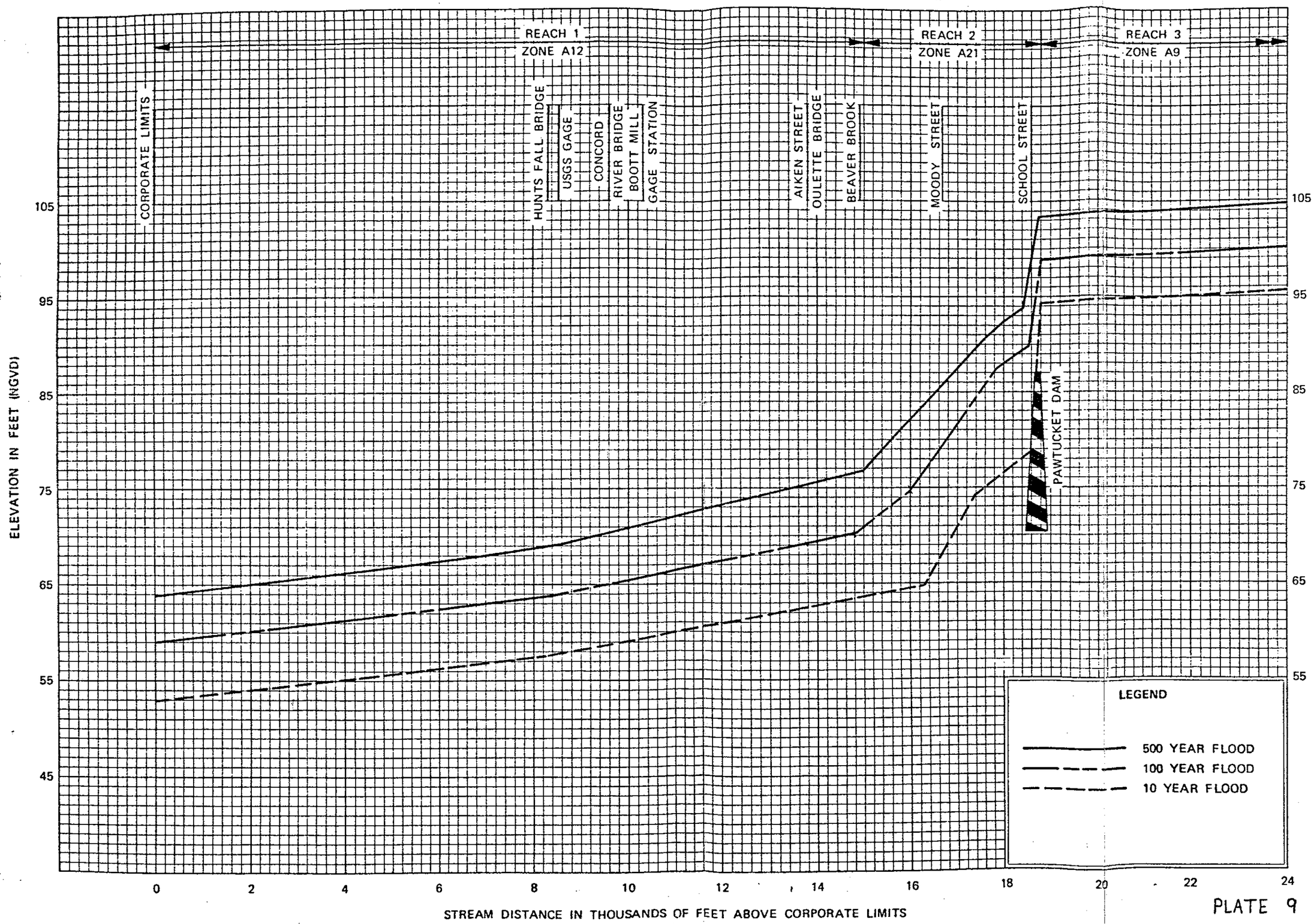

REACH 1
ZONE A12
REACH 2
ZONE A21
REACH 3
ZONE A9
CORPORATE LIMITS
HUNTS FALL BRIDGE
USGS GAGE
CONCORD
RIVER BRIDGE
BOOTT MILL
GAGE STATION
AIKEN STREET
OULETTE BRIDGE
BEAVER BROOK
MOODY STREET
SCHOOL STREET
PAWTUCKET DAM
ELEVATION IN FEET (NGVD)
105
95
85
75
65
55
45
0
2
4
6
8
10
12
14
16
18
20
22
24
STREAM DISTANCE IN THOUSANDS OF FEET ABOVE CORPORATE LIMITS
LEGEND
500 YEAR FLOOD
100 YEAR FLOOD
10 YEAR FLOOD

PLATE 9

INTERIOR FLOOD POTENTIAL

HIGH: GENERALLY EXCEEDING 5'. EXTENSIVE PROPERTY LOSS. THREAT TO HUMAN LIFE.

MED: GENERALLY 3-5' EXTENSIVE PROPERTY LOSS LITTLE THREAT TO LIFE.

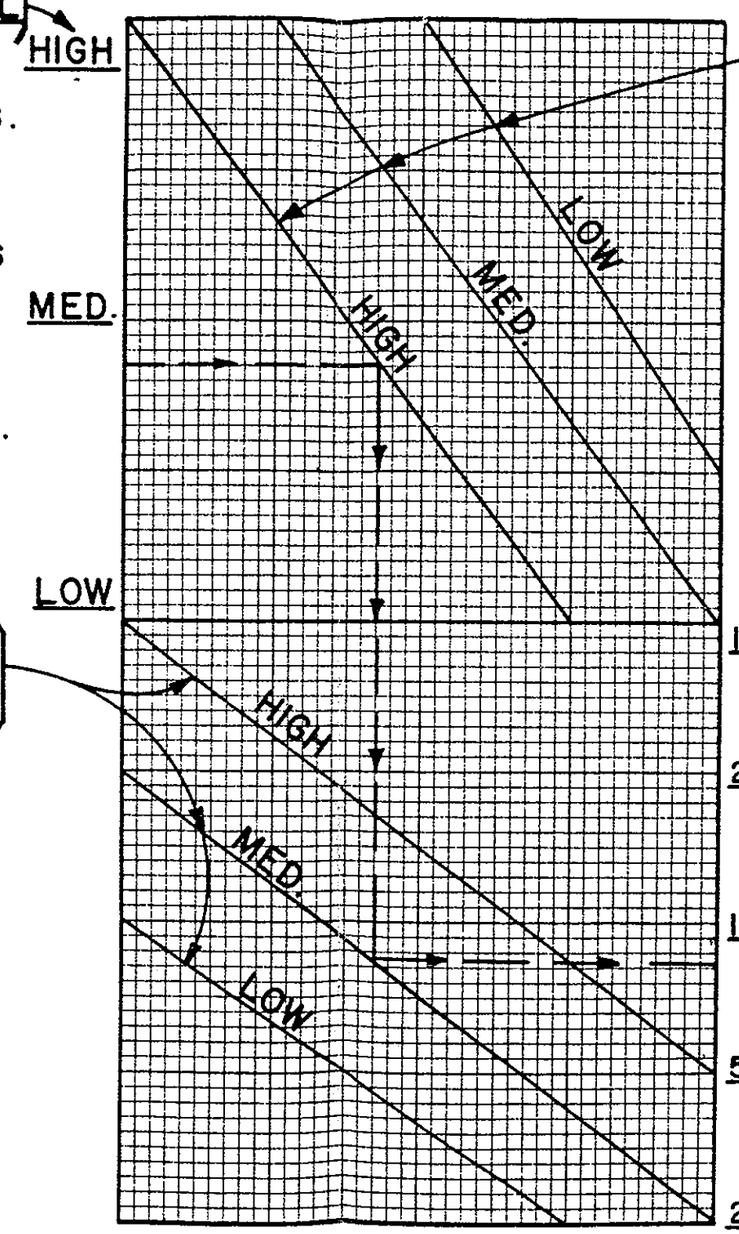
LOW: GENERALLY 1-3' IN STREETS AND LOW AREAS MODERATE PROPERTY LOSS.

INTERIOR RUNOFF-AND RIVER STAGE COINCIDENCE

HIGH: INTERIOR RUNOFF AND RIVER GENERALLY PEAK WITHIN 1 TO 4 HOURS OF EACH OTHER.

MED: RUNOFF AND RIVER GENERALLY PEAK WITHIN 4 TO 12 HOURS OF EACH OTHER.

LOW: RIVER RISE GENERALLY MORE THAN 12 HOURS AFTER INTENSE RAINFALL.



FREQUENCY OF RIVER STAGE REQUIRING PUMPING

HIGH: GENERALLY MORE THEN 5 YR. FREQUENCY.

MED: 5 YR. TO 20 YR. FREQUENCY.

LOW: LESS THAN 20 YR. FREQUENCY.

RELATIVE RUNOFF FREQUENCY FOR INTERIOR DRAINAGE DESIGN

LOCAL PROTECTION PROJECTS

GUIDE CHART FOR HYDROLOGIC REVIEW OF INTERIOR PUMPING CAPACITIES

FEB. 1983

LOWELL LOCAL PROTECTION

INTERIOR WATERSHED MAP

PLATE II